2016 Semiannual Groundwater Monitoring Report

Palermo Wellfield Superfund Site
Tumwater, Washington

for
Washington State Department of Transportation

April 21, 2017

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Earth Science + Technology

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File No. 0180-121-11

April 21, 2017

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1.0 INTRODUCTION

This draft report summarizes the Spring (April) 2016 semiannual groundwater monitoring results for the Palermo Wellfield Superfund Site (Site), United States Environmental Protection Agency (EPA) ID: WA 0000026534, located in Tumwater, Washington (Figure 1).

Washington State Department of Transportation (WSDOT) began groundwater monitoring at the Site in 2013. From 2004 through 2012, EPA conducted long-term, semiannual groundwater monitoring for tetrachloroethene (perchloroethylene – PCE) and trichloroethene (TCE) as part of the remedy selected for the Site, documented in the Record of Decision (ROD) dated November 16, 1999 (EPA 1999).

In the spring of 1999, EPA began operating an air stripping treatment system at the Palermo Wellfield (Wellfield) to remove TCE from groundwater and prevent introduction into the City's water supply. Operation and maintenance of the groundwater treatment system is the responsibility of the City of Tumwater (City) based on an agreement with EPA.

TCE and PCE also were detected in surface water samples from the base of the Palermo bluff where surface water ponded in the yards and crawl spaces of nearby homes within the Palermo Neighborhood (Neighborhood). EPA constructed a subdrain system and treatment lagoon in 2000 in the Neighborhood. The subdrain system includes a subgrade perforated piping network installed behind the seven southern-most houses west of SE Rainier Avenue (Figure 2). The main perforated pipe or "trunk drain" is located beneath the backyards of the houses. Groundwater that enters the perforated pipe flows to an unperforated "tightline" pipe beneath SE Rainier Avenue and SE M Street. The tightline pipe drains to the treatment lagoon located at the Municipal Golf Course. The water is treated by surface aeration to remove PCE and TCE from the water before it is discharged northward to the Deschutes River by way of an existing water course. The purpose of the system is to lower the local groundwater table beneath homes west of SE Rainier Avenue. Following construction and verification of the subdrain and treatment lagoon, a maintenance and monitoring program was established and implemented by the Washington State Department of Ecology (Ecology). Ecology monitored the subdrain and lagoon system performance between 2002 and 2008. From 2009 through 2012, EPA assumed the lead for performance monitoring of the subdrain and treatment lagoon system. WSDOT has been conducting subdrain and lagoon monitoring since 2013 under terms of the Administrative Settlement Agreement and Order on Consent for Response Actions for the project (EPA 2012).

2.0 SCOPE OF WORK

This draft semiannual report summarizes data collected during groundwater and subdrain system sampling performed during April 2016. This draft semiannual report also includes a summary of operations and maintenance activities pertaining to the subdrain and treatment lagoon system. These activities were generally completed using procedures presented in the following documents:

- *Field Sampling and Analysis Plan (FSP) – Semiannual Groundwater Monitoring, Palermo Wellfield Superfund Site (FSP)* (GeoEngineers 2013a).

- *Operation and Maintenance Manual Subdrain System* and *Treatment Lagoon Palermo Wellfield Superfund Site (O&M Manual)* (URSG 2002).
- *Addendum 1 Operation and Maintenance Manual Subdrain System and Treatment Lagoon, Palermo Wellfield Superfund Site* (GeoEngineers 2013b).
- *Addendum 2 Operation and Maintenance Manual Subdrain System and Treatment Lagoon, Palermo Wellfield Superfund Site (*GeoEngineers 2014a).

Activities completed include:

- Collection of groundwater samples and depth to groundwater measurements at 40 monitoring locations.
- Collection of water samples from eight subdrain and treatment lagoon locations.
- Measurement of sediment accumulation and discharge rate at 11 subdrain locations.
- Submittal of groundwater and water samples for laboratory analyses of PCE, TCE, and other selected volatile organic compounds (VOCs).

3.0 GROUNDWATER

This section presents information on semiannual groundwater monitoring field activities and analytical results.

3.1. Semiannual Field Activities

Field activities conducted during the semiannual monitoring events included the following number of locations:

Location Type	Spring 2016
Monitoring Wells	29
Shallow Groundwater Piezometers	11
Seeps	0
Wellfield Locations	0

Attributes of monitoring locations and groundwater level elevations observed during the Spring 2016 sampling event are presented in Tables 1 and 2 and Figures 3 and 4. Field forms associated with the sampling are provided in Appendix A. Specific details about the monitoring locations are described below. Deviations from the FSP are outlined in the Section 3.1.5.

Groundwater and subdrain system water samples were submitted to OnSite Environmental, Inc. in Redmond, Washington, for analysis of the following VOCs using EPA SW-846 Method 8260C:

- Trichloroethene (TCE);
- Tetrachloroethene (PCE);
- Cis-1,2-dichloroethene (cis-1,2-DCE);

- Trans-1,2-dichloroethene (trans-1,2-DCE);
- Vinyl chloride (VC); and
- 1,1-Dichloroethene (1,1-DCE).

3.1.1. *Monitoring Wells*

Groundwater from 29 monitoring wells was sampled as identified in the FSP (GeoEngineers 2013a). Samples were generally collected using a portable Grundfos submersible pump at monitoring wells with the exception of monitoring wells MW-93-02 and MW-96-17 which were sampled using a peristaltic pump and an internal hand pump, respectively. Field parameter measurements were recorded using a multi-parameter water quality meter and a turbidimeter.

3.1.2. *Shallow Groundwater Piezometers*

Groundwater from 11 piezometers was sampled in accordance with the FSP. Piezometer groundwater samples were collected using a peristaltic pump after field parameter stabilization. Piezometer PZ-722 was not sampled because it was damaged beyond repair (the cause of damage is unknown).

3.1.3. *Seeps*

No seep samples were collected during the Spring 2016 sampling event.

3.1.4. *Wellfield Locations*

The Wellfield was under construction during the Spring 2016 sampling event. The City was performing upgrades to the treatment system so no samples were collected from TW-4, TW-8, TW-16, or either stripper tower (ST-1 and ST-2). The upgrades included connection of production wells TW-16 and TW-17 to the treatment system, construction of a well house for TW-16, and a new backup power generator to run the Wellfield during power outages.

3.1.5. *Deviations from the Groundwater Monitoring FSP*

The list outlined below is specific to deviations from the FSP which occurred during the Spring 2016 sampling event.

- Monitoring wells MW-96-17 and MW-93-02 were not sampled with a submersible pump. Monitoring well MW-96-17 was sampled using a permanent internal down-hole pump maintained by the City. A peristaltic pump was used to collect the sample from MW-93-02 because an obstruction (stick) was present in the well casing. The stick was partially removed from the casing by the City during the Fall 2013 monitoring event, but could not be completely extracted.
- The City wells MW-96-15 and MW-96-16 contain a different brand of submersible pump (QED Micropurge pump) which is not compatible with the Grundfos submersible pump system. These pumps were removed before sample collection and then replaced after sampling was completed.
- The Wellfield treatment system was offline during the sampling period so samples were not collected from production wells TW-4, TW-8, TW-16, or the air stripper tower effluent (ST-1 and ST-2).
- Production well TW-5 was not sampled because it was decommissioned in January 2014. Monitoring at this location has been discontinued.

- Monitoring well MW-ES-08 was not sampled because it is located within Lake Park Drive SW as a result of nearby land development. Collecting samples at MW-ES-08 would require a partial lane closure and traffic control. Groundwater monitoring at this location has been temporarily discontinued following discussions with EPA (Zavala 2014).
- Monitoring at four seeps (SEEP-1 through SEEP-3, and SEEP-5) and three piezometers at the base of the bluff (PZ-704, PZ-709, and PZ-715) was discontinued in 2014 following discussions with EPA (Zavala 2014). However, groundwater depth-to-water measurements were collected from piezometers PZ-704, PZ-709, and PZ-715 and at seep locations SEEP-1 through SEEP-3.
- A Hach dissolved iron field test kit was used to measure the concentration of dissolved iron in groundwater. The purpose of the dissolved iron measurement was to provide some indication of potential areas that may be undergoing natural attenuation.
- A groundwater sample was not collected at piezometer PZ-722 because the location appeared to have been damaged and the riser pipe has been compromised. Field observations indicate that bentonite was encountered within the riser pipe and that the piezometer seal was not intact because groundwater was observed seeping out of the seal and around the riser pipe. Bentonite was also observed to have filled the monument rendering this location unsuitable for groundwater sampling at this time.
- In addition, the Barnes Lake water level was measured at the City's staff gauge (Table 2). The gauge is located northeast of the current WSDOT Materials Testing Laboratory and is maintained by the City.

3.2. Groundwater Monitoring Analytical Results

This section describes the results of the laboratory analysis completed for the Spring 2016 sampling event including a data quality assessment, comparison to ROD cleanup goals, and a brief description of the results from each of the three sample location types. Tabulated analytical data are included in Appendix B. Data validation reports are presented in Appendix C. Laboratory analytical reports are presented in Appendix D. Table 3 and Figures 5 and 6 summarize PCE and TCE concentrations at the groundwater monitoring locations.

3.2.1. *Data Quality Assessment*

Data quality for the Spring 2016 semiannual groundwater sampling was found to be acceptable. A detailed assessment is provided in the data validation reports in Appendix C.

3.2.2. *Groundwater Record of Decision Cleanup Goals*

Site groundwater chemicals of concern identified in the 1999 ROD are PCE and TCE (EPA 1999). Analytical results discussed below were evaluated against the ROD remediation goals (RGs) for these chemicals. ROD RGs for PCE and TCE are both 5 micrograms per liter (µg/L), the maximum contaminant level (MCL) for drinking water as referenced in the Federal Clean Water Act.

3.2.3. *Monitoring Wells*

In general, TCE and PCE analytical results from monitoring wells during the Spring 2016 monitoring event were consistent with previous monitoring events.

PCE was detected at concentrations exceeding the 5 µg/L RG in groundwater samples from two of the 29 monitoring wells (MW-ES-04 at 27 µg/L and MW-ES-06 at 29 µg/L) sampled during this event (Figure 5).

TCE was detected at concentrations exceeding the 5 µg/L RG in groundwater samples from eight of the 29 monitoring wells sampled during this event. The maximum concentration of 86 µg/L TCE detected in a groundwater sample was collected from MW-ES-09, located in the Palermo Neighborhood on SE Rainier Avenue (Figure 6). This is the lowest TCE concentration detected except for one event in November 2009 with a TCE concentration of 73 µg/L. Cis-1,2-Dichloroethene was detected at a concentration of 0.24 µg/L in MW-UI. No additional compounds analyzed were detected in groundwater samples from monitoring wells during this spring monitoring event.

3.2.4. *Shallow Groundwater Piezometers*

Similar to monitoring wells, the shallow groundwater piezometer results were relatively consistent with historical results. PCE and TCE analytical results for the piezometers are presented in Figures 5 and 6.

PCE was not detected at concentrations greater than the 5 µg/L RG in piezometer samples collected during this monitoring event. PCE was detected in groundwater samples from two piezometers (PZ-720 at 0.49 µg/L and RPZ-732 at 0.50 µg/L). PCE has historically been detected in PZ-720 at concentrations marginally above the 5 µg/L RG, and in RPZ-732 at concentrations below the RG.

TCE was detected at concentrations exceeding the 5 µg/L in groundwater samples from three of the 12 piezometers sampled (PZ-720 at 9.9 µg/L, PZ-721 at 34 µg/L, and PZ-724 at 23 µg/L). Spring 2016 detected TCE groundwater concentrations ranged from 0.95 µg/L to 34 µg/L. The general downward trend of TCE concentrations in PZ-728 continued, with a TCE concentration of 3.8 µg/L detected during the Spring 2016 sampling event.

Cis-1,2-DCE was detected in groundwater samples from three piezometers (PZ-721, PZ-724 and PZ-728) ranging in concentration from 0.22 µg/L to 0.26 µg/L. No additional compounds were detected from piezometers during the spring sampling.

3.2.5. *Wellfield*

The wellfield wells and the stripper towers were not sampled during the Spring 2016 monitoring event because the treatment system was offline and the wellfield was undergoing upgrades.

4.0 SUBDRAIN AND TREATMENT LAGOON

The purpose of the subdrain and lagoon system is to lower the groundwater depth beneath the homes west of SE Rainier Avenue to at least 18 inches (1.5 feet) below the bottom of the crawlspaces or 3 feet below ground surface (URSG 2002). This decrease in depth to groundwater aims at reducing the potential risk of vapor intrusion into the homes from shallow groundwater that may contain PCE and TCE. Shallow groundwater collected in the subdrain is conveyed via a tightline pipe and treated via surface aeration at the treatment lagoon (Figure 2). The following sections describe the field activities, results, and conclusions for the subdrain and treatment lagoon performance monitoring.

4.1. Field Activities

Field activities performed during the Spring 2016 monitoring event were completed in general accordance with the Operation and Maintenance Manual Subdrain System and Treatment Lagoon Palermo Wellfield

Superfund Site (O&M Manual) (URSG 2002) and Addendum 1 (GeoEngineers 2013b). Activities performed involving the subdrain, tightline, and treatment lagoon are discussed in the following sections.

4.1.1. *Subdrain and Tightline*

The subdrain located behind the seven southern-most houses on the western side of Rainier Avenue SE collects shallow groundwater though an underground perforated pipe system and conveys the water to the treatment lagoon through a solid tightline pipe (Figure 2). This section describes performance monitoring for this portion of the remedy and includes sampling, water elevation monitoring, discharge rate measurements, and sediment accumulation monitoring.

4.1.1.1. SAMPLING

Subdrain cleanout samples were collected using a polyethylene dipper by lowering the cup portion of the dipper into each of the cleanouts, placing it under the outfalls, or submerging it into the water. Samples were submitted to the same laboratory as the groundwater samples under the same chain of custody procedures, and for the same analyses.

4.1.1.2. WATER ELEVATION MONITORING

Depth to water measurements were collected from the Neighborhood piezometers, the subdrain cleanouts and the tightline catch basins using an electronic water level indicator. The measurements were used to calculate groundwater elevations in the Neighborhood (Table 4 and Figure 6).

4.1.1.3. WATER FLOW RATE MEASUREMENTS

Flow rate was measured using a Global Flow Meter as outlined in the site O&M Manual (URSG 2002). Discharge was calculated from the flow rate and water elevation measurements to equate to gallons per minute (gpm). Figure 7 and Table 5 shows the discharge volumes encountered in the subdrain.

4.1.1.4. SEDIMENT ACCUMULATION MONITORING

Total depth measurements were collected using an incrementally marked measuring rod placed inside of each subdrain cleanout and tightline catch basin to assess the sediment accumulated in the subdrain cleanouts and tightline catch basins. Table 6 summarizes the estimated depth of sediment in these structures in comparison to the original surveyed structure bottom. Accumulated debris in clean outs CO-4 and CO-7 exceeded the 0.5-foot threshold in the O&M Manual (URSG 2002).

4.1.2. *Treatment Lagoon*

Treatment lagoon performance is measured semiannually with respect to sampling and flow rate and once a year for sediment accumulation (URSG 2002). Semiannual monitoring occurs at multiple lagoon inflows, treatment lagoon effluent, and a compliance point at the Deschutes River, whereas sediment accumulation monitoring occurs on an annual basis at the treatment lagoon.

4.1.2.1. INFLOWS TO LAGOON

The treatment lagoon receives water from four monitored sources:

- Station 350 – M Street Storm Drain Outfall
- Station 356 – Upstream Watercourse Inflow from the Wetlands
- Station 360 – Tightline Outfall to Treatment Lagoon
- Station 362 – M Street Terminus Catch Basin Outfall

These locations were monitored using the Global Flow Probe, a rigid, incrementally marked tape measure, and dipper for sample collection. The flow probe was used to measure flow rate by placing the probe at the outfall entrance and recording the flow rate. The water level in each outfall was measured using the tape measure. Table 5 summarizes the calculated discharge volume from each of the locations. A sample for chemical analysis was also collected from each of the stations (if flowing) by placing the dipper into the discharge.

4.1.2.2. TREATMENT LAGOON EFFLUENT

Treatment lagoon samples were collected using a polyethylene dipper by lowering and submerging the cup portion into the spillway water. Samples were submitted to the same laboratory as the groundwater samples under the same chain of custody procedures, and for the same analyses.

The treatment lagoon effluent (Station 361) is monitored while aeration is actively occurring. Because the lagoon spillway is armored with rip rap, discharge is measured at an outfall approximately 800 feet downstream at a pond located north of the Tumwater Athletic Club where a more accurate flow rate can be obtained (Table 5).

4.1.2.3. POINT OF COMPLIANCE

The point of compliance (Station 364) is located at the Deschutes River Outfall located approximately 2,000 feet downstream from the treatment lagoon. This location was monitored and sampled using the same equipment and measuring tools described in the preceding sections. Discharge rate for this station also appears in Table 5.

4.1.2.4. SEDIMENT ACCUMULATION MONITORING

Sediment accumulation monitoring was not performed during the Spring 2016 event. Annual sediment accumulation monitoring for the treatment lagoon typically occurs during the fall monitoring event and will be reported in the 2016 Annual Groundwater Report.

4.1.3. *Deviations from the Subdrain and Treatment Lagoon O&M Amendment and QAPP*

The following have been noted as deviations with respect to the Subdrain and Treatment Lagoon O&M Amendment and QAPP:

- Flow rates and samples were not collected at Station 362, M Street Terminus catch basin outfall, for Spring 2016 because no water was present at this location. This is a common occurrence for this outfall.
- A water level measurement was recorded at PZ-722 as part of monitoring the overall functionality of the subdrain system. It was later determined; however, that the measured water level was inaccurate because the piezometer was damaged beyond repair. Water level information for this location has not been included in this report.

4.2. Subdrain and Treatment Lagoon Monitoring Analytical Results

This section describes the results of the laboratory analyses completed for the Spring 2016 sampling event. The data validation reports are presented in Appendix C. Laboratory analytical reports are presented in Appendix D. Table 5 and Figures 5, 6, and 7 summarize PCE and TCE concentrations in groundwater samples collected from piezometers surrounding the subdrain, the subdrain, and treatment lagoon locations.

4.2.1. *Data Quality Assessment*

Data quality for the Spring 2016 semiannual O&M monitoring was found to be acceptable. A detailed assessment is provided in the data validation reports in Appendix C.

4.2.2. *Subdrain*

Concentrations of PCE and TCE were detected in the subdrain samples collected during the Spring 2016 monitoring event. PCE was detected in each of the three cleanout samples, ranging in concentration from 4.4 µg/L to 10 µg/L. TCE was also detected in water samples from the three cleanouts at concentrations ranging from 7.9 µg/L to 14 µg/L.

4.2.3. *Treatment Lagoon*

Monitoring locations for the treatment lagoon are discussed by location including inflows, effluent, and point of compliance.

4.2.3.1. INFLOWS

Inflow results for the treatment lagoon are briefly summarized by location below and in Table 5.

- **Station 350 – M Street Storm Drain Outfall:** TCE was detected in this sample at a concentration of 1.3 µg/L. PCE was not detected at a concentration greater than the detection limit.
- **Station 356 – Upstream Watercourse:** TCE and PCE were not detected at a concentration greater than the detection limit of 0.20 µg/L.
- **Station 360 – Subdrain Tightline Outfall:** PCE was detected at a concentration of 4.1 µg/L and TCE was detected at a concentration of 9.6 µg/L.
- **Station 362 – M Street Terminus Catch Basin Outfall:** Samples were not collected because there was no flow during the Spring 2016 monitoring event.

4.2.3.2. LAGOON EFFLUENT

PCE and TCE concentrations in the lagoon effluent sample (Station 361) collected post-aeration were 0.26 µg/L and 0.73 µg/L, respectively.

4.2.3.3. POINT OF COMPLIANCE

At the point of compliance located at the Deschutes River, PCE was not detected at a concentration greater than the reporting limit of 0.20 µg/L during the Spring 2016 monitoring. TCE was detected at a concentration of 0.41 µg/L, well below the ROD RG as noted below.

4.2.3.4. RECORD OF DECISION SURFACE WATER DISCHARGE CLEANUP GOALS

The objective is to prevent discharge of groundwater containing PCE and TCE in excess of the surface water RG to the Deschutes River. Remediation goals at the point of compliance (Deschutes River) are 0.8 µg/L for PCE and 2.7 µg/L for TCE.

5.0 REFERENCES

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Zavala, 2014. Electronic confirmation regarding no sampling at MW-ES-08, PZ-704, PZ-709, PZ-715, Seeps 1 through 3 and 5. July 15, 2014.

TABLES

GeoEngineers

Table 1

Well Construction Summary

2016 Semiannual Groundwater Monitoring Report

Palermo Wellfield Superfund Site

Tumwater, Washington

Well or Piezometer	Well Location		Measuring Point (TOC) Elevation	Screen Interval Depth (feet bgs)		Geologic Unit of Screen Interval	Approximate Screen Interval Elevation		Notes
	Northing	Easting		Top	Bottom		Top	Bottom	
Bluff Area									
MW-UI	616967.53	1038149.35	178.82	17.7	27.7	unknown	161.1	151.1	1,2,5
WDOT-MW-1	617640.6	1038502.3	166.94	30.0	39.5	SP--dense to medium dense, olive green, fine sand	136.9	127.4	3,4,5
WDOT-MW-2	617572.9	1038517.9	165.45	30.0	39.5	SP--very dense, olive green to orange, fine to medium sand	135.5	126.0	3,4,5
MW-100	616814.53	1037366.22	177.70	20.0	30.0	SP-medium dense, brown, fine to coarse sand	157.7	147.7	1,2,5
MW-101A	617215.6	1038148.2	176.47	65.0	75.0	SP-loose, gray, fine to medium sand	111.5	101.5	3,4,5
MW-101B	617198.3	1038151.0	176.41	25.0	35.0	SP-loose to medium dense, light brown, fine to medium sand	151.4	141.4	3,4,5
MW-102	617461.6	1038109.5	166.96	16.0	26.0	SP-loose to medium dense, gray, fine to medium sand	151.0	141.0	3,4,5
MW-103	617769.2	1038225.6	163.40	11.0	21.0	SP-loose to medium dense, gray, fine to medium sand	152.4	142.4	3,4,5
MW-104A	617862.7	1039673.3	170.63	119.0	129.0	SP-medium dense to dense, brown, fine sand	51.6	41.6	3,4,5
MW-104B	617868.8	1039667.6	170.52	52.0	62.0	SP-medium dense, brown, fine grained sand	118.5	108.5	3,4,5
MW-109	617312.79	1038552.35	168.89	64.5	74.5	SP-medium dense to dense, brown, fine to coarse sand	104.4	94.4	1,2,5
MW-111	617663.43	1038824.43	165.41	30.0	40.0	SP-medium dense, brown, fine to medium sand	135.4	125.4	1,2,5
MW-ES-02	617664.68	1039666.61	174.65	95.0	105.0	SM-silty sand	79.7	69.7	1,2,5
MW-ES-03	617546.79	1039463.97	175.07	113.0	123.0	SP to SP-SM-sand with silt	62.1	52.1	1,2,5
MW-ES-04	617548.74	1039477.60	175.11	50.0	60.0	SM/ML/SM-silty sand, sandy silt, silty sand	125.1	115.1	1,2,5
MW-ES-05	617517.36	1039178.92	175.05	86.0	96.0	SP-SM-fine sand with silt	89.1	79.1	1,2,5
MW-ES-06	617517.59	1039200.03	173.30	46.0	56.0	SP-SM-sand +/- silt	127.3	117.3	1,2,5
MW-ES-07	617139.20	1037976.58	177.89	25.0	35.0	SP-sand SP-sand with gravel	152.9	142.9	1,2,5
MW-ES-08	617163.60	1037049.22	177.17	25.0	35.0	SP-SM-sand +/- silt	152.2	142.2	1,2,5
MW-ES-11	617571.6	1038487.8	166.25	80.0	90.0	SW, well graded sand	86.3	76.3	3,4,5
MW-96-15	617161.5	1038944.6	168.85	69.0	79.0	medium fine sand	99.9	89.9	3,4,5
MW-96-16	616828.9	1039709.4	179.58	50.5	60.5	fine medium sand	129.1	119.1	3,4,5
MW-96-17	616770.8	1039836.2	179.51	45.5	55.5	fine brown sand	134.0	124.0	3,4,5
Deschutes Valley Area									
MW-4A	617600.7	1040468.7	109.87	100	110	silty sand and gravel	9.9	-0.1	3,4,5
MW-4B	617600.7	1040468.7	109.83	80	90	silty sand	29.8	19.8	3,4,5
MW-ES-09	617769.4	1040014.5	108.29	20	30	SP-poorly graded sand with silty sand interbed	88.3	78.3	3,4,5
MW-ES-10	617780.1	1040014.3	108.21	82	92	unknown (no description)	26.2	16.2	3,4,5
MW-107	617052.39	1041164.92	114.66	25.0	35.0	ML-very hard, moist, gray silt SP-loose to medium dense, brown, medium to coarse sand	89.7	79.7	1,2,5
MW-110	618032.42	1041013.21	101.93	30.0	40.0	SP-loose to medium dense, gray, fine to medium sand	71.9	61.9	1,2,5
MW-93-02	617159.3	1040344.3	112.84	6.0	11.0	fine silty blue sand brown clay	106.8	101.8	3,4,5
PZ-704	618090.0	1039826.6	110.64	5	7.5	fine to coarse sand with cobbles and boulders	105.6	103.1	3,4,5
PZ-709	617880.0	1039819.2	114.67	5	7.5	fine to coarse sand with cobbles and boulders	109.7	107.2	3,4,5
PZ-715	617683.4	1039815.4	117.82	5	7.5	fine to coarse sand with cobbles and boulders	112.8	110.3	3,4,5
PZ-719	618201.2	1040000.0	106.95	7	10	fine to medium sand	100.0	97.0	3,4,5
PZ-720	618026.8	1039993.1	107.55	7	10	fine to medium sand	100.6	97.6	3,4,5
PZ-721	617874.3	1039991.4	108.15	7	10	fine to medium sand	101.2	98.2	3,4,5
PZ-722	617664.8	1039983.7	108.74	7	10	fine to medium sand	101.7	98.7	3,4,5
PZ-723	618244.6	1040200.8	106.22	7	10	fine to medium sand	99.2	96.2	3,4,5
PZ-724	617976.5	1040198.5	106.28	7	10	fine to medium sand	99.3	96.3	3,4,5
PZ-725	617741.8	1040220.5	107.88	7	10	fine to medium sand	100.9	97.9	3,4,5
PZ-726	618186.5	1040452.6	105.23	7	10	fine to medium sand	98.2	95.2	3,4,5
PZ-728	617851.9	1040464.5	105.11	7	10	fine to medium sand	98.1	95.1	3,4,5
RPZ-730	618230.9	1040684.5	103.85	4.13	9.13	log not on file	99.7	94.7	3,4,5
RPZ-731	617984.7	1040739.1	105.18	4.75	9.75	log not on file	100.4	95.4	3,4,5
RPZ-732	617722.2	1040690.6	105.67	4.63	9.63	log not on file	101.0	96.0	3,4,5
Palermo Wellfield									
TW-4	617493.7	1040659.3	108.95	60	90	large gravel and sand	49.0	19.0	3,4,5
TW-8	617398.0	1040445.6	109.93	70	90	medium to coarse sand and gravel	39.9	19.9	3,4,5
TW-16	617596.0	1040717.2	109.43	54	93	sand and gravel	55.4	16.4	3,4,5

Notes:

Well/piezometer screen interval depths were determined by others during previous investigations.

Geologic units for screened intervals were determined by GeoEngineers based on review of logging information by others from previous investigations.

[1] Existing well locations and TOC elevations were obtained from previous explorations (Parametrix 2012, URS 1999 and personal communications with EPA 2013).

[2] Horizontal Datum: NAD83 WA State Plane North.

[3] Survey performed by Skillings Connolly, Inc. in October, 2014.

[4] Horizontal Datum: Washington Coordinate System NAD83/11, south zone, based on network RTK GPS ties to WSDOT control points.

[5] Vertical Datum: North American Vertical Datum of 1988 (NAVD 88).

bgs = below ground surface

TOC = top of casing

Table 2

Groundwater Depths and Elevations

2016 Semiannual Groundwater Monitoring Report

Palermo Wellfield Superfund Site

Tumwater, Washington

Location	Top-of-Casing Elevation (feet NAVD 88)	Spring 2016	
		Depth-to-Water (feet)	Water Level Elevation (feet NAVD 88)
Monitoring Wells			
MW-4A	109.87	4.79	105.08
MW-4B	109.83	4.92	104.91
MW-93-02	112.84	4.04	108.80
MW-96-15	168.85	22.52	146.33
MW-96-16	179.58	44.50	135.08
MW-96-17	179.51	46.00	133.51
MW-100	177.70	14.52	163.18
MW-101A	176.47	17.12	159.35
MW-101B	176.41	17.35	159.06
MW-102	166.96	8.23	158.73
MW-103	163.40	5.32	158.08
MW-104A	170.63	50.65	119.98
MW-104B	170.52	47.63	122.89
MW-107	114.66	7.02	107.64
MW-109	168.89	16.89	152.00
MW-110	101.93	2.24	99.69
MW-111	165.41	22.78	142.63
MW-ES-02	174.65	51.31	123.34
MW-ES-03	175.07	45.62	129.45
MW-ES-04	175.11	46.11	129.00
MW-ES-05	175.05	40.43	134.62
MW-ES-06	173.30	40.78	132.52
MW-ES-07	177.89	17.85	160.04
MW-ES-09	108.29	-0.58	108.87
MW-ES-10	108.21	-2.25	110.46
MW-ES-11	166.25	13.01	153.24
MW-UI	178.82	17.00	161.82
WDOT-MW-1	166.94	16.69	150.25
WDOT-MW-2	165.45	15.05	150.40
Piezometers			
PZ-704	110.64	4.18	106.46
PZ-709	114.67	2.27	112.40
PZ-715	117.82	3.18	114.64
PZ-719	106.95	1.83	105.12
PZ-720	107.55	3.22	104.33
PZ-721	108.15	2.40	105.75
PZ-722	108.74	Damaged beyond repair	–
PZ-723	106.22	2.13	104.09
PZ-724	106.28	0.74	105.54
PZ-725	107.88	1.93	105.95
PZ-726	105.23	2.66	102.57
PZ-728	105.11	1.95	103.16
RPZ-730	103.85	2.25	101.60
RPZ-731	105.18	3.72	101.46
RPZ-732	105.67	4.34	101.33
Production Wells			
TW-4	108.95	6.20	102.75
TW-8	109.93	4.40	105.53
TW-16	109.43	8.15	101.28
Barnes Lake	157.402*	-3.44	160.84

Notes:

*Elevation of 0.00 Feet on the Barnes Lake staff gauge.

-- = Not applicable

NAVD = North American Vertical Datum of 1988

Groundwater depth-to-water measurements were collected from monitoring wells, piezometers, production wells, and Barnes Lake on April 18, 2016.

Table 3

TCE and PCE Detected in Groundwater and Seep Samples

2016 Semiannual Groundwater Monitoring Report
Palermo Wellfield Superfund Site
Tumwater, Washington

Analyte		Tetrachloroethene	Trichloroethene
ROD Remediation Goal		5	5
Location ID	Date	(µg/L)	(µg/L)
MW-100	5/12/2004	0.5 U	0.5 U
MW-100	9/21/2004	1 U	0.5 U
MW-100	4/26/2005	0.5 U	0.5 U
MW-100	10/5/2005	0.5 U	0.5 U
MW-100	3/16/2006	1 U	1 U
MW-100	10/30/2006	1 U	1 U
MW-100	6/6/2007	1 U	1 U
MW-100	11/12/2007	1 U	1 U
MW-100	5/19/2008	0.5 U	0.5 U
MW-100	10/27/2008	1 U	1 U
MW-100	4/27/2009	0.5 U	0.5 U
MW-100	11/9/2009	0.5 U	0.5 U
MW-100	5/19/2010	0.5 U	0.5 U
MW-100	10/19/2010	0.5 U	0.5 U
MW-100	5/23/2011	0.5 U	0.5 U
MW-100	11/8/2011	0.5 U	0.5 U
MW-100	5/29/2012	0.5 U	0.5 U
MW-100	3/5/2013	1 U	1 U
MW-100	9/19/2013	0.5 U	0.5 U
MW-100	4/15/2014	0.20 U	0.20 U
MW-100	8/20/2014	0.20 UJ	0.20 UJ
MW-100	3/10/2015	0.20 U	0.20 U
MW-100	8/26/2015	0.20 U	0.20 U
MW-100	4/19/2016	0.20 U	0.20 U
MW-101A	3/17/2006	1 U	1 U
MW-101A	5/29/2012	0.5 U	0.5 U
MW-101A	3/6/2013	1 U	1 U
MW-101A	9/17/2013	0.5 U	0.5 U
MW-101A	4/15/2014	0.20 U	0.20 U
MW-101A	8/21/2014	0.20 UJ	0.20 UJ
MW-101A	3/11/2015	0.20 U	0.20 U
MW-101A	8/26/2015	0.20 U	0.20 U
MW-101A	4/19/2016	0.20 U	0.20 U
MW-101B	3/17/2006	0.1 J	14
MW-101B	10/31/2006	1 U	6.2
MW-101B	6/6/2007	1 U	5.5
MW-101B	11/13/2007	1 U	5.7
MW-101B	5/20/2008	0.5 U	6.2
MW-101B	10/28/2008	1 U	3.9
MW-101B	4/28/2009	0.5 U	17
MW-101B	11/10/2009	0.5 U	2.2
MW-101B	5/19/2010	0.5 U	3.6
MW-101B	10/21/2010	0.5 U	3.3
MW-101B	5/24/2011	0.5 U	2.2
MW-101B	11/8/2011	0.5 U	3.7
MW-101B	5/29/2012	0.5 U	2.7
MW-101B	3/5/2013	1 U	3.0
MW-101B	9/17/2013	0.5 U	3.3
MW-101B	4/15/2014	0.20 U	2.9
MW-101B	8/21/2014	0.20 UJ	2.7 J
MW-101B	3/11/2015	0.20 U	2.7
MW-101B	8/26/2015	0.20 U	2.8
MW-101B	4/19/2016	0.20 U	2.8
MW-102	6/4/2012	0.5 U	0.5 U
MW-102	3/5/2013	1 U	1 U
MW-102	9/17/2013	0.5 U	0.5 U
MW-102	4/17/2014	0.20 U	0.20 U
MW-102	8/22/2014	0.20 UJ	0.20 UJ
MW-102	3/11/2015	0.20 U	0.20 U
MW-102	8/27/2015	0.20 U	0.20 U
MW-102	4/20/2016	0.20 U	0.20 U
MW-103	6/4/2012	0.5 U	0.5 U
MW-103	3/6/2013	1 U	1 U
MW-103	9/18/2013	0.5 U	0.5 U
MW-103	4/16/2014	0.20 U	0.20 U
MW-103	8/22/2014	0.20 UJ	0.20 UJ
MW-103	3/11/2015	0.20 U	0.20 U
MW-103	8/27/2015	0.20 U	0.20 U
MW-103	4/20/2016	0.20 U	0.20 U
MW-104A	3/17/2006	1 U	6.6
MW-104A	10/31/2006	1 U	11
MW-104A	6/4/2012	0.5 U	5.3
MW-104A	3/7/2013	1 U	8.0
MW-104A	9/27/2013	0.5 U	4.6
MW-104A	4/18/2014	0.20 U	3.9
MW-104A	8/28/2014	0.20 U	4.5
MW-104A	3/12/2015	0.20 U	5.0
MW-104A	8/31/2015	0.20 U	4.0
MW-104A	4/22/2016	0.20 U	3.9
MW-104B	5/11/2004	1.9	0.26 J
MW-104B	9/21/2004	1.6	0.5 U
MW-104B	4/26/2005	0.97	0.5 U
MW-104B	10/6/2005	0.09	0.5 U
MW-104B	3/16/2006	1.5	1 U
MW-104B	10/31/2006	1.7	1 U
MW-104B	6/7/2007	1.9	1 U
MW-104B	11/13/2007	2.4	1 U
MW-104B	5/20/2008	1.3	0.5 U
MW-104B	10/28/2008	1.6	1 U
MW-104B	4/29/2009	5 U	5 U

Analyte		Tetrachloroethene	Trichloroethene
ROD Remediation Goal		5	5
Location ID	Date	(µg/L)	(µg/L)
MW-ES-07	5/20/2008	0.5 U	8.6
MW-ES-07	10/28/2008	1 U	6.9
MW-ES-07	4/28/2009	0.5 U	4.7
MW-ES-07	11/10/2009	0.5 U	3.6
MW-ES-07	5/19/2010	0.5 U	4.8
MW-ES-07	10/21/2010	0.5 U	5.1
MW-ES-07	5/24/2011	0.5 U	4.5
MW-ES-07	11/8/2011	0.5 U	9.7
MW-ES-07	5/29/2012	0.5 U	4.4
MW-ES-07	3/5/2013	1 U	3.9
MW-ES-07	9/17/2013	0.5 U	7.0
MW-ES-07	4/15/2014	0.20 U	4.3
MW-ES-07	8/20/2014	0.20 UJ	4.2 J
MW-ES-07	3/11/2015	0.20 U	3.8
MW-ES-07	8/28/2015	0.20 U	4.5
MW-ES-07	4/19/2016	0.20 U	4.6
MW-ES-08	5/29/2012	0.5 U	0.5 U
MW-ES-08	3/5/2013	1 U	1 U
MW-ES-08	9/19/2013	0.5 U	0.5 U
MW-ES-09	5/11/2004	0.5 U	220
MW-ES-09	9/22/2004	1 U	200
MW-ES-09	4/27/2005	0.5 U	300
MW-ES-09	10/6/2005	0.5 U	120
MW-ES-09	3/22/2006	1 U	176
MW-ES-09	11/2/2006	1 U	170
MW-ES-09	6/8/2007	1 U	169
MW-ES-09	11/14/2007	1 U	160
MW-ES-09	5/21/2008	0.5 U	150
MW-ES-09	10/29/2008	1 U	150
MW-ES-09	4/30/2009	5 U	140
MW-ES-09	11/11/2009	0.5 U	73
MW-ES-09	5/21/2010	0.5 U	150
MW-ES-09	10/22/2010	0.5 U	130
MW-ES-09	5/26/2011	0.5 U	120
MW-ES-09	11/9/2011	0.5 U	150
MW-ES-09	6/5/2012	0.5 U	150 J
MW-ES-09	3/11/2013	1 U	120
MW-ES-09	9/26/2013	1 U	120
MW-ES-09	4/21/2014	1.0 U	110
MW-ES-09	8/28/2014	0.40 U	100
MW-ES-09	3/16/2015	0.40 U	99
MW-ES-09	8/28/2015	0.20 U	97
MW-ES-09	4/22/2016	0.40 U	86
MW-ES-10	5/11/2004	0.5 U	83
MW-ES-10	9/22/2004	1 U	83
MW-ES-10	4/27/2005	0.5 U	78
MW-ES-10	10/6/2005	0.5 U	75
MW-ES-10	3/22/2006	1 U	65
MW-ES-10	11/2/2006	1 U	68
MW-ES-10	6/8/2007	1 U	63
MW-ES-10	11/14/2007	1 U	61
MW-ES-10	5/21/2008	0.5 U	46
MW-ES-10	10/29/2008	1 U	52
MW-ES-10	4/30/2009	5 U	34
MW-ES-10	11/11/2009	0.5 U	29
MW-ES-10	5/21/2010	0.5 U	53
MW-ES-10	10/22/2010	0.5 U	52
MW-ES-10	5/26/2011	0.5 U	36
MW-ES-10	11/9/2011	0.5 U	53
MW-ES-10	6/5/2012	0.5 U	67 J
MW-ES-10	3/11/2013	1 U	37
MW-ES-10	9/26/2013	0.5 U	36
MW-ES-10	4/22/2014	0.20 U	35
MW-ES-10	8/28/2014	0.20 U	32
MW-ES-10	3/16/2015	0.20 U	37
MW-ES-10	8/31/2015	0.20 U	32
MW-ES-10	4/22/2016	0.20 U	29
MW-ES-11	5/31/2012	0.5 U	0.5 U
MW-ES-11	3/6/2013	1 U	1 U
MW-ES-11	9/17/2013	0.5 U	0.5 U
MW-ES-11	4/17/2014	0.20 U	0.22
MW-ES-11	8/25/2014	0.20 UJ	0.30 J
MW-ES-11	3/17/2015	0.20 U	0.33
MW-ES-11	8/27/2015	0.20 U	0.27
MW-ES-11	4/20/2016	0.20 U	0.31
MW-UI	5/12/2004	0.5 U	21 J
MW-UI	9/21/2004	1 U	17
MW-UI	4/26/2005	0.5 U	8.8
MW-UI	10/5/2005	0.5 U	3.6
MW-UI	3/17/2006	1 U	5.2
MW-UI	10/31/2006	1 U	12
MW-UI	6/6/2007	1 U	23
MW-UI	11/12/2007	1 U	28
MW-UI	5/19/2008	0.5 U	16
MW-UI	10/28/2008	1 U	8.3
MW-UI	4/27/2009	0.5 U	7.9
MW-UI	11/10/2009	0.5 U	3.8
MW-UI	5/19/2010	0.5 U	7.8
MW-UI	10/19/2010	0.5 U	8.1
MW-UI	5/24/2011	0.5 U	11

Analyte		Tetrachloroethene	Trichloroethene
ROD Remediation Goal		5	5
Location ID	Date	(µg/L)	(µg/L)
MW-104B	11/11/2009	0.87	0.5 U
MW-104B	5/20/2010	1.4	0.057 J
MW-104B	10/22/2010	1.8	0.5 U
MW-104B	5/26/2011	0.95	0.5 U
MW-104B	11/9/2011	1.6	0.5 U
MW-104B	6/4/2012	1.3	0.5 U
MW-104B	3/11/2013	1.4	1 U
MW-104B	9/27/2013	1.5	0.5 U
MW-104B	4/18/2014	0.99	0.20 U
MW-104B	8/28/2014	1.0	0.20 U
MW-104B	3/12/2015	1.1	0.20 U
MW-104B	8/31/2015	1.1	0.20 U
MW-104B	4/22/2016	0.82	0.20 U
MW-107	6/7/2012	0.5 U	0.5 U
MW-107	3/6/2013	1 U	1 U
MW-107	9/20/2013	0.5 U	0.5 U
MW-107	4/18/2014	0.20 U	0.20 U
MW-107	8/27/2014	0.20 U	0.20 U
MW-107	3/13/2015	0.20 U	0.20 U
MW-107	8/28/2015	0.20 U	0.20 U
MW-107	4/21/2016	0.20 U	0.20 U
MW-109	5/12/2004	0.5 U	31
MW-109	9/21/2004	1 U	32
MW-109	4/26/2005	0.5 U	15
MW-109	10/5/2005	0.5 U	22
MW-109	3/20/2006	1 U	27
MW-109	11/1/2006	1 U	25
MW-109	6/7/2007	1 U	22
MW-109	11/13/2007	1 U	22
MW-109	5/20/2008	0.5 U	10
MW-109	10/28/2008	1 U	20
MW-109	4/28/2009	0.5 U	17
MW-109	11/10/2009	0.5 U	8.3
MW-109	5/19/2010	0.5 U	16
MW-109	10/21/2010	0.5 U	17
MW-109	5/24/2011	0.5 U	13
MW-109	11/8/2011	0.5 U	19
MW-109	5/30/2012	0.5 U	13
MW-109	3/5/2013	1 U	15
MW-109	9/18/2013	0.5 U	16
MW-109	4/16/2014	0.20 U	15
MW-109	8/21/2014	0.20 UJ	14 J
MW-109	3/10/2015	0.20 U	15
MW-109	8/28/2015	0.20 U	14
MW-109	4/19/2016	0.20 U	14
MW-110	5/12/2004	0.5 U	0.5 U
MW-110	9/21/2004	1 U	0.5 U
MW-110	4/26/2005	0.5 U	0.5 U
MW-110	10/5/2005	0.5 U	0.5 U
MW-110	3/15/2006	1 U	1U
MW-110	10/31/2006	1 U	1 U
MW-110	6/6/2007	1 U	1 U
MW-110	11/12/2007	1 U	1 U
MW-110	5/20/2008	0.5 U	0.5 U
MW-110	10/28/2008	1 U	1 U
MW-110	4/28/2009	0.5 U	0.5 U
MW-110	11/10/2009	0.5 U	0.5 U
MW-110	5/19/2010	0.5 U	0.5 U
MW-110	10/20/2010	0.5 U	0.5 U
MW-110	5/24/2011	0.5 U	0.5 U
MW-110	11/8/2011	0.5 U	0.5 U
MW-110	6/7/2012	0.5 U	0.5 U
MW-110	3/6/2013	1 U	1 U
MW-110	9/20/2013	0.5 U	0.5 U
MW-110	4/18/2014	0.20 U	0.20 U
MW-110	8/27/2014	0.20 U	0.20 U
MW-110	3/13/2015	0.20 U	0.20 U
MW-110	8/28/2015	0.20 U	0.20 U
MW-110	4/21/2016	0.20 U	0.20 U
MW-111	5/12/2004	0.5 U	22
MW-111	9/21/2004	1 U	17
MW-111	4/26/2005	0.5 U	0.5 U
MW-111	10/5/2005	0.5 U	12
MW-111	3/17/2006	1 U	20
MW-111	11/1/2006	1 U	16
MW-111	6/6/2007	1 U	18
MW-111	11/13/2007	1 U	16
MW-111	5/20/2008	0.5 U	14
MW-111	10/28/2008	1 U	17
MW-111	4/28/2009	0.5 U	11
MW-111	11/10/2009	0.5 U	5.8
MW-111	5/19/2010	0.5 U	12
MW-111	10/21/2010	0.5 U	11
MW-111	5/24/2011	0.5 U	12
MW-111	11/8/2011	0.5 U	13
MW-111	5/30/2012	0.5 U	12
MW-111	3/7/2013	1 U	9.1
MW-111	9/19/2013	0.5 U	9.2
MW-111	4/16/2014	0.20 U	8.4
MW-111	8/22/2014	0.20 UJ	7.7 J
MW-111	3/11/2015	0.20 U	8.8
MW-111	8/27/2015	0.20 U	8.5
MW-111	4/21/2016	0.20 U	8.3

Analyte		Tetrachloroethene	Trichloroethene
ROD Remediation Goal		5	5
Location ID	Date	(µg/L)	(µg/L)
MW-UI	11/8/2011	0.5 U	11
MW-UI	5/29/2012	0.5 U	9.3
MW-UI	3/5/2013	1 U	8.1
MW-UI	9/19/2013	0.5 U	6.6
MW-UI	4/15/2014	0.20 U	7.9
MW-UI	8/20/2014	0.20 UJ	7.3 J
MW-UI	3/10/2015	0.20 U	7.1
MW-UI	8/26/2015	0.20 U	4.1
MW-UI	4/19/2016	0.20 U	10
PZ-704	6/6/2012	0.5 U	0.5 U
PZ-704	3/13/2013	1 U	1 U
PZ-704	9/23/2013	0.5 U	0.5 U
PZ-704	4/21/2014	0.20 U	0.20 U
PZ-709	6/6/2012	0.5 U	0.5 U
PZ-709	3/13/2013	1 U	1 U
PZ-709	9/23/2013	0.2 UJ	0.2 UJ
PZ-709	4/21/2014	0.20 U	0.20 U
PZ-715	6/6/2012	0.5 U	0.5 U
PZ-715	3/13/2013	1 U	1 U
PZ-715	9/23/2013	0.5 U	0.5 U
PZ-715	4/21/2014	0.20 U	0.20 U
PZ-719	6/6/2012	0.5 U	1.7
PZ-719	3/14/2013	1 U	1.6
PZ-719	9/24/2013	0.5 U	2.1
PZ-719	1/28/2014	0.20 U	2.0
PZ-719	4/18/2014	0.20 U	1.8
PZ-719	8/18/2014	0.20 UJ	1.5 J
PZ-719	3/16/2015	0.20 U	2.1
PZ-719	8/24/2015	0.20 U	2.1
PZ-719	4/28/2016	0.20 U	2.2
PZ-720	2/1/2004	1.1	17
PZ-720	6/6/2012	0.5 U	6.6 J
PZ-720	3/14/2013	0.38 J	5.0
PZ-720	9/24/2013	0.55	9.7
PZ-720	1/29/2014	0.51	6.7
PZ-720	4/18/2014	0.40	5.5
PZ-720	8/19/2014	0.94	16
PZ-720	3/16/2015	0.52	12
PZ-720	8/24/2015	0.82	18
PZ-720	4/28/2016	0.49	9.9
PZ-721	2/1/2004	0.79	98
PZ-721	3/15/2006	0.40 J	47
PZ-721	11/2/2006	0.69 J	59
PZ-721	6/5/2007	1 U	35
PZ-721	11/14/2007	0.53 J	52
PZ-721	5/21/2008	0.39 J	41
PZ-721	10/27/2008	1 U	19
PZ-721	4/30/2009	5 U	35
PZ-721	11/11/2009	0.5 U	27
PZ-721	5/19/2010	0.20 J	41
PZ-721	10/20/2010	0.5 U	48
PZ-721	5/26/2011	0.5 U	30
PZ-721	11/10/2011	0.5 U	44
PZ-721	6/6/2012	0.5 U	38
PZ-721	3/14/2013	1 U	30
PZ-721	9/24/2013	0.5 U	54
PZ-721	1/29/2014	0.20 U	34
PZ-721	4/22/2014	0.20 U	37
PZ-721	8/19/2014	0.40 U	61
PZ-721	3/16/2015	0.20 U	42
PZ-721	8/24/2015	0.29	49
PZ-721	4/28/2016	0.20 U	34
PZ-722	6/6/2012	0.5 U	0.5 U
PZ-722	3/14/2013	1 U	1 U
PZ-722	9/25/2013	0.5 U	0.5 U
PZ-722	1/29/2014	0.20 U	0.20 U
PZ-722	4/22/2014	0.20 U	0.20 U
PZ-722	8/19/2014	0.20 U	0.20 U
PZ-722	3/17/2015	0.20 U	0.20 U
PZ-722	8/24/2015	0.20 U	0.20 U
PZ-723	6/6/2012	0.5 U	0.5 U
PZ-723	3/14/2013	1 U	1 U
PZ-723	9/25/2013	0.5 U	0.5 U
PZ-723	1/28/2014	0.20 U	0.20 U
PZ-723	4/23/2014	0.20 U	0.20 U
PZ-723	8/18/2014	0.20 UJ	0.20 UJ
PZ-723	3/17/2015	0.20 U	0.20 U
PZ-723	8/25/2015	0.20 U	0.20 U
PZ-723	4/27/2016	0.20 U	0.20 U
PZ-724	2/1/2004	0.45 J	39
PZ-724	3/15/2006	0.3 J	28
PZ-724	11/2/2006	1 U	37
PZ-724	6/5/2007	1 U	15
PZ-724	11/14/2007	1 U	32
PZ-724	5/21/2008	0.22 J	87
PZ-724	10/27/2008	1 U	44
PZ-724	4/30/2009	5 U	35
PZ-724	11/11/2009	0.5 U	28
PZ-724	5/19/2010	0.5 U	34
PZ-724	10/20/2010	0.5 U	43
PZ-724	5/26/2011	0.5 U	30
PZ-724	11/10/2011	0.5 U	53
PZ-724	6/7/2012	0.5 U	13

Analyte		Tetrachloroethene	Trichloroethene
ROD Remediation Goal		5	5
Location ID	Date	(µg/L)	(µg/L)
MW-4A	3/20/2006	1 U	1 U
MW-4A	6/5/2012	0.5 U	0.5 U
MW-4A	3/12/2013	1 U	1 U
MW-4A	9/26/2013	0.5 U	0.5 U
MW-4A	4/22/2014	0.20 U	0.20 U
MW-4A	8/28/2014	0.20 U	0.20 U
MW-4A	3/13/2015	0.20 U	0.20 U
MW-4A	8/28/2015	0.20 U	0.20 U
MW-4A	4/20/2016	0.20 U	0.20 U
MW-4B	3/20/2006	1 U	1 U
MW-4B	6/5/2012	0.5 U	0.5 U
MW-4B	3/12/2013	1 U	1 U
MW-4B	9/26/2013	0.5 U	0.5 U
MW-4B	4/22/2014	0.20 U	0.20 U
MW-4B	8/28/2014	0.20 U	0.20 U
MW-4B	3/13/2015	0.20 U	0.20 U
MW-4B	8/28/2015	0.20 U	0.20 U
MW-4B	4/20/2016	0.20 U	0.20 U
MW-93-02	6/5/2012	0.5 U	0.5 U
MW-93-02	3/12/2013	1 U	1 U
MW-93-02	9/20/2013	0.5 U	0.5 U
MW-93-02	4/17/2014	0.20 U	0.20 U
MW-93-02	8/28/2014	0.20 U	0.20 U
MW-93-02	3/13/2015	0.20 U	0.20 U
MW-93-02	9/1/2015	0.20 U	0.20 U
MW-93-02	4/21/2016	0.20 U	0.20 U
MW-96-15	5/30/2012	0.5 U	0.5 U
MW-96-15	3/7/2013	1 U	1 U
MW-96-15	9/17/2013	0.5 U	0.5 U
MW-96-15	4/17/2014	0.20 U	0.20 U
MW-96-15	8/26/2014	0.20 U	0.20 U
MW-96-15	3/17/2015	0.20 U	0.20 U
MW-96-15	9/1/2015	0.20 U	0.20 U
MW-96-15	4/20/2016	0.20 U	0.20 U
MW-96-16	6/5/2012	0.5 U	0.5 U
MW-96-16	3/6/2013	1 U	1 U
MW-96-16	9/18/2013	0.5 U	0.5 U
MW-96-16	4/16/2014	0.20 U	0.20 U
MW-96-16	8/26/2014	0.20 U	0.20 U
MW-96-16	3/17/2015	0.20 U	0.20 U
MW-96-16	9/1/2015	0.20 U	0.20 U
MW-96-16	4/21/2016	0.20 U	0.20 U
MW-96-17	6/5/2012	0.5 U	0.5 U
MW-96-17	3/6/2013	1 U	1 U
MW-96-17	9/18/2013	0.5 U	0.5 U
MW-96-17	4/15/2014	0.20 U	0.20 U
MW-96-17	8/26/2014	0.20 U	0.20 U
MW-96-17	3/13/2015	0.20 U	0.20 U
MW-96-17	9/1/2015	0.20 U	0.20 U
MW-96-17	4/21/2016	0.20 U	0.20 U
MW-ES-02	3/22/2006	1 U	56
MW-ES-02	11/1/2006	1 U	68
MW-ES-02	6/7/2007	1 U	66
MW-ES-02	11/14/2007	1 U	66
MW-ES-02	5/20/2008	0.5 U	47
MW-ES-02	10/29/2008	1 U	50
MW-ES-02	4/29/2009	5 U	43
MW-ES-02	11/11/2009	0.5 U	29
MW-ES-02	5/20/2010	0.5 U	53
MW-ES-02	10/22/2010	0.5 U	58
MW-ES-02	5/26/2011	0.5 U	46
MW-ES-02	11/8/2011	0.5 U	51
MW-ES-02	5/31/2012	0.5 U	47
MW-ES-02	3/7/2013	1 U	38
MW-ES-02	9/20/2013	0.5 U	39
MW-ES-02	4/21/2014	0.20 U	39
MW-ES-02	8/27/2014	0.20 U	34
MW-ES-02	3/11/2015	0.20 U	40
MW-ES-02	8/28/2015	0.20 U	40
MW-ES-02	4/22/2016	0.20 U	36
MW-ES-03	5/11/2004	0.5 U	37
MW-ES-03	9/22/2004	1 U	42
MW-ES-03	4/27/2005	0.5 U	22
MW-ES-03	10/6/2005	0.13 J	22
MW-ES-03	3/20/2006	1 U	27
MW-ES-03	11/1/2006	1 U	22
MW-ES-03	6/7/2007	1 U	26
MW-ES-03	11/14/2007	1 U	26
MW-ES-03	5/21/2008	0.5 U	24
MW-ES-03	10/29/2008	1 U	25
MW-ES-03	4/29/2009	5 U	16
MW-ES-03	11/12/2009	0.5 U	12
MW-ES-03	5/20/2010	0.5 U	21
MW-ES-03	10/21/2010	0.5 U	25
MW-ES-03	5/25/2011	0.5 U	21
MW-ES-03	11/9/2011	0.5 U	27
MW-ES-03	6/4/2012	0.5 U	21
MW-ES-03	3/7/2013	1 U	17
MW-ES-03	9/19/2013	0.5 U	18
MW-ES-03	4/17/2014	0.20 U	16
MW-ES-03	8/27/2014	0.20 U	14
MW-ES-03	3/12/2015	0.20 U	16
MW-ES-03	8/31/2015	0.20 U	14
MW-ES-03	4/21/2016	0.20 U	15

Analyte		Tetrachloroethene	Trichloroethene
ROD Remediation Goal		5	5
Location ID	Date	(µg/L)	(µg/L)
PZ-724	3/14/2013	1 U	32
PZ-724	9/25/2013	0.5 U	43
PZ-724	1/29/2014	0.20 U	40
PZ-724	4/22/2014	0.20 U	29
PZ-724	8/19/2014	0.20 U	41
PZ-724	3/16/2015	0.20 U	34
PZ-724	8/24/2015	0.20 U	47
PZ-724	4/28/2016	0.20 U	23
PZ-725	2/1/2004	0.5 U	0.35 J
PZ-725	6/8/2012	0.5 U	0.5 U
PZ-725	3/14/2013	1 U	1 U
PZ-725	9/24/2013	0.5 U	0.5 U
PZ-725	1/29/2014	0.20 U	0.20 U
PZ-725	4/22/2014	0.20 U	0.20 U
PZ-725	8/19/2014	0.20 U	0.20 U
PZ-725	3/17/2015	0.20 U	0.20 U
PZ-725	8/24/2015	0.20 U	0.20 U
PZ-725	4/28/2016	0.20 U	0.20 U
PZ-726	2/1/2004	0.5 U	3.1
PZ-726	6/8/2012	0.5 U	3.4 J
PZ-726	3/12/2013	1 U	2.7
PZ-726	9/25/2013	0.5 U	3.8
PZ-726	1/28/2014	0.20 U	3.2
PZ-726	4/23/2014	0.20 U	3.1
PZ-726	8/18/2014	0.20 UJ	3.6 J
PZ-726	3/17/2015	0.20 U	3.7
PZ-726	8/25/2015	0.20 U	3.7
PZ-726	4/27/2016	0.20 U	3.4
PZ-728	2/1/2004	0.5 U	31
PZ-728	3/15/2006	1 U	24
PZ-728	11/2/2006	1 U	16
PZ-728	6/5/2007	1 U	18
PZ-728	11/14/2007	1 U	21
PZ-728	5/21/2008	0.5 U	14
PZ-728	10/27/2008	1 U	51
PZ-728	4/30/2009	5 U	9.1
PZ-728	11/11/2009	0.5 U	8.2
PZ-728	5/19/2010	0.5 U	10
PZ-728	10/20/2010	0.5 U	12
PZ-728	5/26/2011	0.5 U	6.0
PZ-728	11/10/2011	0.5 U	7.7
PZ-728	6/8/2012	0.5 U	4.5 J
PZ-728	3/7/2013	1 U	4.7
PZ-728	9/25/2013	0.5 U	5.1
PZ-728	1/29/2014	0.20 U	4.2
PZ-728	4/23/2014	0.20 U	4.2
PZ-728	8/18/2014	0.20 UJ	4.0 J
PZ-728	3/16/2015	0.20 U	4.9
PZ-728	8/25/2015	0.20 U	3.9
PZ-728	4/27/2016	0.20 U	3.8
RPZ-730	6/4/2012	0.5 U	0.5 U
RPZ-730	3/13/2013	1 U	1 U
RPZ-730	9/24/2013	0.5 U	0.5 U
RPZ-730	1/28/2014	0.20 U	0.20 U
RPZ-730	4/23/2014	0.20 U	0.20 U
RPZ-730	8/18/2014	0.20 UJ	0.20 UJ
RPZ-730	3/17/2015	0.20 U	0.20 U
RPZ-730	8/25/2015	0.20 U	0.20 U
RPZ-730	4/27/2016	0.20 U	0.20 U
RPZ-731	6/4/2012	0.5 U	0.61
RPZ-731	3/13/2013	1 U	0.60 J
RPZ-731	9/24/2013	0.5 U	1.6
RPZ-731	1/29/2014	0.20 U	0.64
RPZ-731	4/23/2014	0.20 U	0.65
RPZ-731	8/19/2014	0.20 U	1.6
RPZ-731	3/17/2015	0.20 U	0.75
RPZ-731	8/25/2015	0.20 U	2.1
RPZ-731	4/27/2016	0.20 U	0.95
RPZ-732	6/5/2012	0.5 U	0.5 U
RPZ-732	3/12/2013	1 U	1 U
RPZ-732	9/24/2013	0.5 U	0.5 U
RPZ-732	1/29/2014	0.20 U	0.20 U
RPZ-732	4/22/2014	0.23	0.20 U
RPZ-732	8/19/2014	0.29	0.20 U
RPZ-732	3/16/2015	0.36	0.20 U
RPZ-732	8/25/2015	0.37	0.20 U
RPZ-732	4/27/2016	0.50	0.20 U
Seep 1	5/30/2012	0.5 U	0.5 U
Seep 1	3/19/2013	1 U	1 U
Seep 1	10/2/2013	0.5 U	0.5 U
Seep 1	4/21/2014	0.20 U	0.20 U
Seep 2	5/30/2012	0.5 U	0.5 U
Seep 2	3/19/2013	1 U	1 U
Seep 2	10/2/2013	0.5 U	0.5 U
Seep 2	4/21/2014	0.20 U	0.20 U
Seep 3	5/31/2012	0.5 U	0.5 U
Seep 3	3/19/2013	1 U	1 U
Seep 3	10/2/2013	0.5 U	0.5 U
Seep 3	4/21/2014	0.20 U	0.20 U
Seep 5	5/31/2012	0.5 U	0.5 U
Seep 5	5/31/2012	0.5 U	0.5 U
Seep 5	3/19/2013	1 U	1 U
Seep 5	10/2/2013	0.5 U	0.5 U
Seep 5	4/21/2014	0.20 U	0.20 U

Analyte		Tetrachloroethene	Trichloroethene
ROD Remediation Goal		5	5
Location ID	Date	(µg/L)	(µg/L)
MW-ES-04	5/11/2004	58	0.52
MW-ES-04	9/22/2004	52	0.44 J
MW-ES-04	4/27/2005	51	0.35 J
MW-ES-04	10/6/2005	38	0.24 J
MW-ES-04	3/20/2006	48	0.8 J
MW-ES-04	11/1/2006	43	1.2
MW-ES-04	6/7/2007	35	1.2
MW-ES-04	11/14/2007	38	1.7
MW-ES-04	5/21/2008	49	1.8
MW-ES-04	10/29/2008	25	1.1
MW-ES-04	4/29/2009	21	0.56 J
MW-ES-04	11/12/2009	16	0.38 J
MW-ES-04	5/20/2010	42	0.64 J
MW-ES-04	10/21/2010	34	0.60
MW-ES-04	5/25/2011	23	0.52
MW-ES-04	11/9/2011	26	0.75
MW-ES-04	6/4/2012	31	0.82
MW-ES-04	3/8/2013	44	0.56 J
MW-ES-04	9/19/2013	32	0.5 U
MW-ES-04	4/17/2014	34	0.31
MW-ES-04	8/27/2014	16	0.20 U
MW-ES-04	3/12/2015	33	0.26
MW-ES-04	8/31/2015	36	0.21
MW-ES-04	4/21/2016	27	0.22
MW-ES-05	5/11/2004	0.5 U	46 J
MW-ES-05	9/22/2004	1 U	44
MW-ES-05	4/26/2005	0.5 U	52
MW-ES-05	10/5/2005	0.5 U	37
MW-ES-05	3/21/2006	1 U	46
MW-ES-05	11/1/2006	1 U	58
MW-ES-05	6/7/2007	1 U	54
MW-ES-05	11/13/2007	1 U	53
MW-ES-05	5/21/2008	0.21 J	58
MW-ES-05	10/29/2008	1 U	41
MW-ES-05	4/29/2009	5 U	27
MW-ES-05	11/11/2009	0.5 U	16
MW-ES-05	5/20/2010	0.5 U	33
MW-ES-05	10/22/2010	0.5 U	36
MW-ES-05	5/25/2011	0.5 U	30
MW-ES-05	11/9/2011	0.5 U	35
MW-ES-05	5/30/2012	0.5 U	32
MW-ES-05	3/8/2013	1 U	27
MW-ES-05	9/20/2013	0.5 U	27
MW-ES-05	4/21/2014	0.20 U	25
MW-ES-05	8/27/2014	0.20 U	24
MW-ES-05	3/12/2015	0.20 U	26
MW-ES-05	8/28/2015	0.20 U	24
MW-ES-05	4/22/2016	0.20 U	25
MW-ES-06	5/11/2004	31	11
MW-ES-06	9/22/2004	26	11
MW-ES-06	4/26/2005	15	4.6
MW-ES-06	10/5/2005	19	11
MW-ES-06	3/21/2006	25	16
MW-ES-06	11/1/2006	34	12
MW-ES-06	6/7/2007	49	6.1
MW-ES-06	11/13/2007	40	6.9
MW-ES-06	5/21/2008	16	4.7
MW-ES-06	10/29/2008	18	5.7
MW-ES-06	4/29/2009	16	5 U
MW-ES-06	11/11/2009	11	2.3
MW-ES-06	5/20/2010	18	3.1
MW-ES-06	10/22/2010	14	2.7
MW-ES-06	5/25/2011	26	1.2
MW-ES-06	11/9/2011	36	1.6
MW-ES-06	5/30/2012	34	1.2
MW-ES-06	3/8/2013	23	0.97 J
MW-ES-06	9/20/2013	27	0.76
MW-ES-06	4/21/2014	13	1.1
MW-ES-06	8/28/2014	15	0.71
MW-ES-06	3/12/2015	13	0.95
MW-ES-06	8/28/2015	21	0.57
MW-ES-06	4/22/2016	29	0.20 U
MW-ES-07	3/20/2006	0.1 J	7.8
MW-ES-07	10/31/2006	1 U	11
MW-ES-07	6/6/2007	1 U	10
MW-ES-07	11/13/2007	1 U	11

Analyte		Tetrachloroethene	Trichloroethene
ROD Remediation Goal		5	5
Location ID	Date	(µg/L)	(µg/L)
ST-1	6/5/2007	1.0 U	1.0 U
ST-1	11/14/2007	1.0 U	1.0 U
ST-1	5/21/2008	0.5 U	0.5 U
ST-1	10/29/2008	1.0 U	1.0 U
ST-1	5/23/2011	0.5 U	0.5 U
ST-1	11/7/2011	0.5 U	0.5 U
ST-1	4/18/2014	0.20 U	0.20 U
ST-1	8/25/2014	0.20 U	0.20 U
ST-2	6/5/2007	1.0 U	1.0 U
ST-2	11/14/2007	1.0 U	1.0 U
ST-2	5/21/2008	0.5 U	0.5 U
ST-2	4/29/2009	0.5 U	0.5 U
ST-2	11/10/2009	0.5 U	0.5 U
ST-2	5/18/2010	0.5 U	0.5 U
ST-2	10/20/2010	0.5 U	0.5 U
ST-2	6/11/2012	0.5 U	0.5 U
ST-2	3/7/2013	1.0 U	1.0 U
ST-2	9/18/2013	0.5 U	0.5 U
TW-4	3/15/2006	1.0 U	3.4
TW-4	11/2/2006	1.0 U	2.1
TW-4	6/4/2007	1.0 U	3.3
TW-4	11/14/2007	1.0 U	2.2
TW-4	5/21/2008	0.5 U	0.61
TW-4	10/29/2008	1.0 U	1.3
TW-4	4/30/2009	0.5 U	1.3
TW-4	11/10/2009	0.5 U	0.85
TW-4	5/18/2010	0.5 U	1.1
TW-4	10/20/2010	0.5 U	0.76
TW-4	5/23/2011	0.5 U	0.5 U
TW-4	11/7/2011	0.5 U	0.5 U
TW-4	6/11/2012	0.5 U	0.71 J
TW-4	3/7/2013	1.0 U	1.7
TW-4	9/18/2013	0.5 U	1.3
TW-4	4/18/2014	0.20 U	0.43
TW-4	8/25/2014	0.20 U	0.89
TW-4	3/16/2015	0.20 U	0.20 U
TW-5	3/15/2006	1.0 U	7.4
TW-5	11/2/2006	1.0 U	6.5
TW-5	6/5/2007	1.0 U	10
TW-5	11/14/2007	1.0 U	8.4
TW-5	5/21/2008	0.5 U	3.8
TW-5	10/29/2008	1.0 U	3.7
TW-5	4/29/2009	0.5 U	2.5
TW-5	11/10/2009	0.5 U	1.1
TW-5	5/18/2010	0.5 U	1.2
TW-5	10/20/2010	0.5 U	0.5 U
TW-5	5/23/2011	0.5 U	0.5 U
TW-5	11/7/2011	0.5 U	0.5 U
TW-5	6/11/2012	0.5 U	0.5 U
TW-5	3/7/2013	1.0 U	1.0 U
TW-5	9/18/2013	0.5 U	0.5 U
TW-8	6/11/2012	0.5 U	0.5 U
TW-8	3/7/2013	1.0 U	1.0 U
TW-8	9/18/2013	0.5 U	0.5 U
TW-8	4/18/2014	0.20 U	0.20 U
TW-8	8/25/2014	0.20 U	0.20 U
TW-8	3/16/2015	0.20 U	0.20 U
TW-16	4/18/2014	0.20 U	9.6
TW-16	8/27/2014	0.20 U	19
TW-16	3/16/2015	0.20 U	10
WDOT-MW-1	5/31/2012	0.5 U	0.5 U
WDOT-MW-1	3/7/2013	1 U	1 U
WDOT-MW-1	9/18/2013	0.5 U	0.5 U
WDOT-MW-1	4/16/2014	0.20 U	0.20 U
WDOT-MW-1	8/25/2014	0.20 UJ	0.20 UJ
WDOT-MW-1	3/12/2015	0.20 U	0.20 U
WDOT-MW-1	8/27/2015	0.20 U	0.20 U
WDOT-MW-1	4/20/2016	0.20 U	0.20 U
WDOT-MW-2	5/31/2012	0.5 U	0.5 U
WDOT-MW-2	3/6/2013	1 U	1 U
WDOT-MW-2	9/18/2013	0.5 U	0.5 U
WDOT-MW-2	4/16/2014	0.20 U	0.20 U
WDOT-MW-2	8/25/2014	0.20 UJ	0.20 UJ
WDOT-MW-2	3/12/2015	0.20 U	0.20 U
WDOT-MW-2	8/27/2015	0.20 U	0.20 U
WDOT-MW-2	4/20/2016	0.20 U	0.20 U

Notes:

µg/L = microgram per liter
J = detected above the method detection limit but below the reporting limit
U = not detected at or above the reporting limit
Bold font type indicates the analyte was detected above the reporting limit.
Gray shading indicates the analyte was detected above the ROD Remediation Goal.
Samples were also analyzed for 1,1-DCE, trans-1,2-DCE, cis-1,2-DCE and vinyl chloride.

Table 4

Neighborhood Piezometer Elevations

2016 Semiannual Groundwater Monitoring Report

Palermo Wellfield Superfund Site

Tumwater, Washington

Location	Top-of-Casing Elevation (feet)[1,2]	Ground Surface Elevation (feet)[1,2]	Spring 2016	
			Depth to Water April 18, 2016 (feet BTOC)	Groundwater Elevation (feet)[2]
Bluff and Rainier Avenue Piezometers				
PZ-704	110.64	108.52	4.18	106.46
PZ-709	114.67	111.99	2.27	112.40
PZ-715	117.82	115.56	3.18	114.64
PZ-720	107.55	108.08	3.22	104.33
PZ-721	108.15	108.35	2.40	105.75
PZ-722	108.74	109.02	Damaged beyond repair	–
Other Neighborhood Piezometers				
PZ-719	106.95	107.36	1.83	105.12
PZ-723	106.22	106.72	2.13	104.09
PZ-724	106.28	106.77	0.74	105.54
PZ-725	107.88	108.39	1.93	105.95
PZ-726	105.23	105.63	2.66	102.57
PZ-728	105.11	105.69	1.95	103.16
RPZ-730	103.85	104.36	2.25	101.60
RPZ-731	105.18	105.41	3.72	101.46
RPZ-732	105.67	105.93	4.34	101.33

Notes:

BTOC = below top of casing

[1]Elevations surveyed by Skillings Connolly, October 2014.

[2]NAVD 88/11 = North American Vertical Datum of 1988/2011.

Table 5

Discharge Volume and Analytical Results - Subdrain and Lagoon

2016 Semiannual Groundwater Monitoring Report

Palermo Wellfield Superfund Site

Tumwater, Washington

Location	Station Description	Volume (GPM) Units	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)
Flow in Sub-Drain System				
357	Cleanout CO-6	63	**10**	**7.9**
358	Cleanout CO-4	142	**7.0**	**14**
359	Cleanout CO-1	158	**4.4**	**10**
360	Tightline Pipe Outfall	190	**4.1**	**9.6**
Treatment Lagoon Inflows (Non-Sub-Drain)				
350	M Street Storm Drain Outfall	111	0.20 U	**1.3**
356	Watercourse Upstream of Lagoon	NC	0.20 U	0.20 U
362	M Street Terminus Catch Basin Outfall (rarely flows)	NF	NS	NS
Treatment Lagoon Effluent				
361	Lagoon Effluent	1,667	**0.26**	**0.73**
Deschutes River Point of Compliance				
364	Deschutes River Outfall	1,906	0.20 U	**0.41**
	Deschutes River Discharge Remediation Goal		**0.8**	**2.7**

Notes:

GPM = gallons per minute

µg/L = microgram per liter

NS = not sampled

NF = no flow; not calculated

NC = not calculated because flow was too slow to measure

U = parameter not detected above the reporting limit

Bold font type indicates analyte was detected

Samples were also analyzed for 1,1-DCE, trans-1,2-DCE, cis-1,2-DCE and vinyl chloride. These compounds were not detected.

Table 6

Sediment Accumulation in Catch Basins and Cleanouts in Subdrain System

2016 Semiannual Groundwater Monitoring Report

Palermo Wellfield Superfund Site

Tumwater, Washington

Location	Depth to Water (feet)	Water Elevation (feet)[1]	Original Total Depth (Feb. 2001) (feet)	Measured Total Depth (feet)	Net Change[2] (feet)	Catch Basin and Subdrain Cleanout Observations
Spring 2016						
CB-1	5.18	100.09	7.78	7.90	-0.12	Gravel flowing in from west pipe and being deposited in sump, roots visible in outlet, fast flow, hard (rocky) bottom.
CB-2	6.57	101.35	8.78	8.75	0.03	Free of debris, fast flow, hard sump bottom.
CB-3	6.24	101.59	8.81	8.86	-0.05	Free of debris, fast flow, soft sump bottom.
CO-1 (359)	6.15	102.13	7.82	7.73	0.09	Free of debris, moderate flow, soft sump bottom, turbulent.
CO-2	5.66	102.29	7.10	7.16	-0.06	Free of debris, moderate flow, soft sump bottom.
CO-3	5.47	102.41	6.84	6.73	0.11	Free of debris, moderate flow, hard sump bottom.
CO-4 (358)	6.15	102.47	7.84	7.06	0.78	Numerous roots in pipe, fast flow, hard sump bottom.
CO-5	6.58	102.62	7.84	7.46	0.38	Free of debris, moderate flow, soft sump bottom.
CO-6 (357)	5.32	104.33	7.70	7.38	0.32	Free of debris, slow flow, soft sump bottom, water ponded over cleanout lid.
CO-7	6.21	104.43	7.89	7.12	0.77	Some roots visible in pipe, slow flow, soft sump bottom.
CO-8	6.29	104.45	8.10	7.81	0.29	Free of debris, slow flow, soft sump bottom, strong odor.

Notes:

Exceeds 0.5 foot accumulated sediment (Section 4.2.1 Trunk Drain, O&M Manual, URS 2002)

[1]NAVD 88/11 = North American Vertical Datum of 1988/2011.

[2]Net change = original total depth from February 2001 minus the measured total depth.

FIGURES

GeoEngineers

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Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. TW-3. TW-16 and TW-17 are installed but not operating.

Data Source: Long-term monitoring locations provided by Parametrix 2012 and modified using surveyed well and piezometer locations by Skillings Connolly, Inc, Oct. 2014.
Imagery from Thurston County GIS 2015.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

- Monitoring well and identifier
- Piezometer and identifier
- Groundwater seep and identifier
- City production well and identifier
- City test well and identifier
- Stripper tower and identifier
- Barnes Lake staff gauge
- Former city production well and identifier
- Former monitoring well and identifier

Site Plan

Palermo Wellfield Superfund Site

GeoEngineers

Figure 1

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2016_SpringReport\Figure02_NeighborhoodPlan_SpringGWReport2016.mxd Date Exported: 03/30/17 by cchelf

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. TW-3, TW-16 and TW-17 are installed but not operating.

Data Source: Long-term monitoring locations from Parametrix 2012. Subdrain layout provided by URS 2000 and modified using surveyed cleanout and catch basin point locations by Skillings Connolly, Inc. Oct 2014, Imagery from Thurston County GIS 2015.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

- Monitoring well and identifier
- Piezometer and identifier
- Groundwater seep and identifier
- City production well and identifier
- City test well and identifier
- Stripper tower and identifier
- Former city production well and identifier
- Catch basin and identifier
- Subdrain cleanout sampling station and identifier
- Treatment lagoon sampling station and identifier
- Cleanout location and identifier
- Subdrain tightline pipe
- Subdrain perforated pipe

N W E S

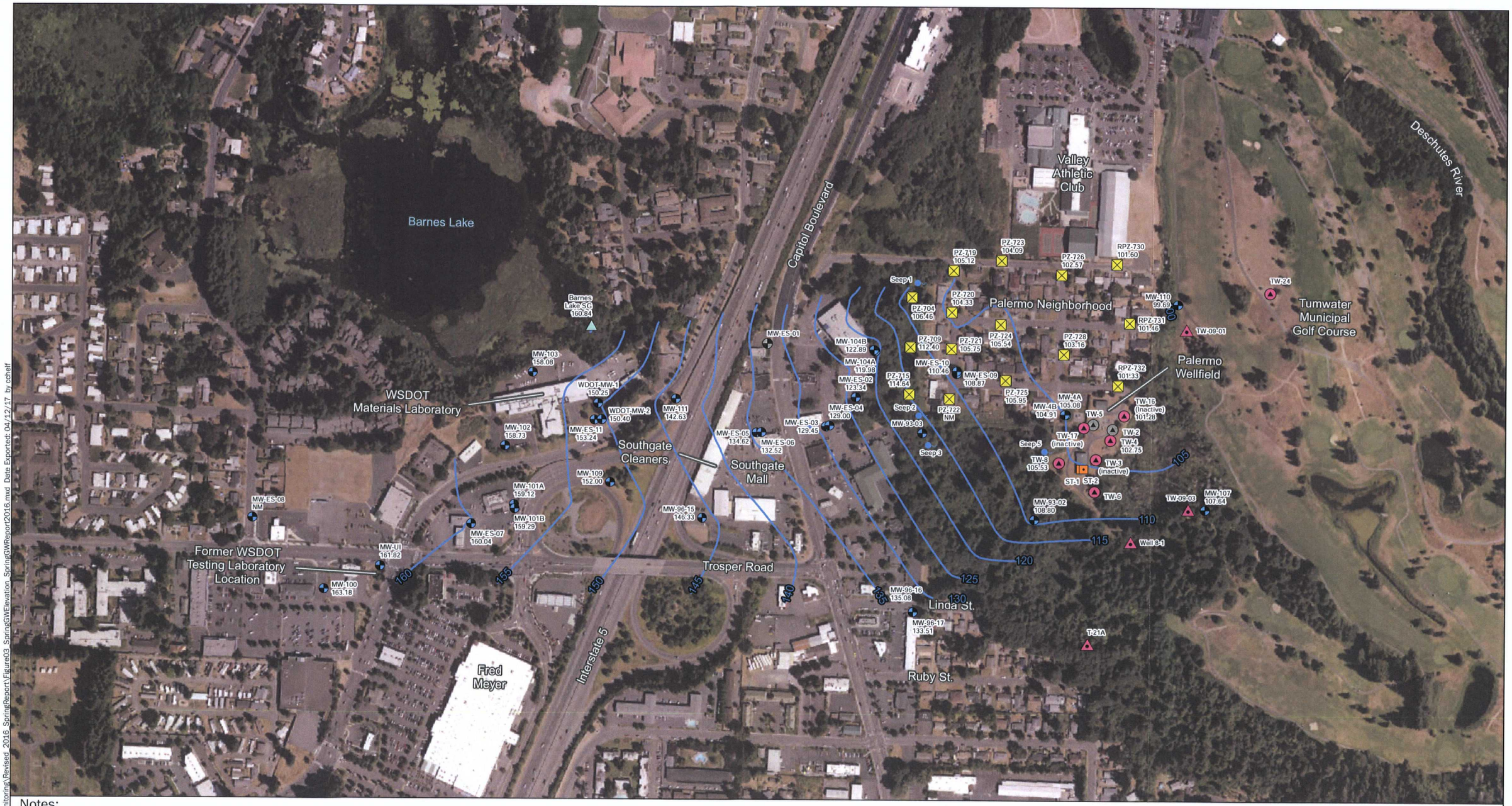
120 0 120
Feet

Palermo Neighborhood and Subdrain

Palermo Wellfield Superfund Site

GeoEngineers

Figure 2



Notes:

1. TW-3, TW-16 and TW-17 are installed but not operating.
2. Groundwater levels measured April 18, 2016.
3. Groundwater elevation contours estimated using Surfer (Golden Software) 8.0 contouring software using the Natural Neighbor gridding method.
4. Groundwater elevations are relative to NAVD 88.
5. The locations of all features shown are approximate.
6. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc.and will serve as the official record of this communication.

Data Source: Long-term monitoring locations provided by Parametrix 2012 and modified using surveyed well and piezometer locations by Skillings Connolly, Inc, Oct. 2014. Imagery from Thurston County 2015.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

- Monitoring well and identifier
- Piezometer and identifier
- Groundwater seep and identifier
- City production well and identifier
- City test well and identifier
- Stripper tower and identifier
- Barnes Lake staff gauge
- Former city production well and identifier
- Former monitoring well and identifier
- 100 Estimated groundwater elevation
- NM Not Measured

N W E S

400 0 400
Feet

Spring 2016
Generalized Groundwater Elevations

Palermo Wellfield Superfund Site

GeoEngineers

Figure 3

P:\01\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2016_SpringReport\Figure03_SpringGWElevation_SpringGWReport2016.mxd Date Exported: 04/12/17 by cheif

P:\O\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2016_SpringReport\Figure04_SpringSubdrainGWElevations_SpringGWReport2016.mxd Date Exported: 04/06/17 by cchelf

Notes:

1. Contours were generated using Surfer 8.0 (Golden Software) contouring software using the natural neighbor gridding method from water levels measured on April 18th and 26th, 2016.
2. Groundwater elevations are relative to NAVD 88.
3. The locations of all features shown are approximate.
4. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Long-term monitoring locations from Parametrix 2012. Subdrain layout provided by URS 2000 and modified using surveyed cleanout and catch basin point locations by Skillings Connolly, Inc. Oct 2014, Imagery from Thurston County 2015.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

- Monitoring well and identifier
- Piezometer and identifier
- Groundwater seep and identifier
- City production well and identifier
- City test well and identifier
- Stripper tower and identifier
- Former city production well and identifier
- Catch basin and identifier
- Subdrain cleanout sampling station and identifier
- Treatment lagoon sampling station and identifier
- Cleanout location and identifier
- Subdrain tightline pipe
- Subdrain perforated pipe
- Estimated or inferred groundwater elevation contours

N W E S

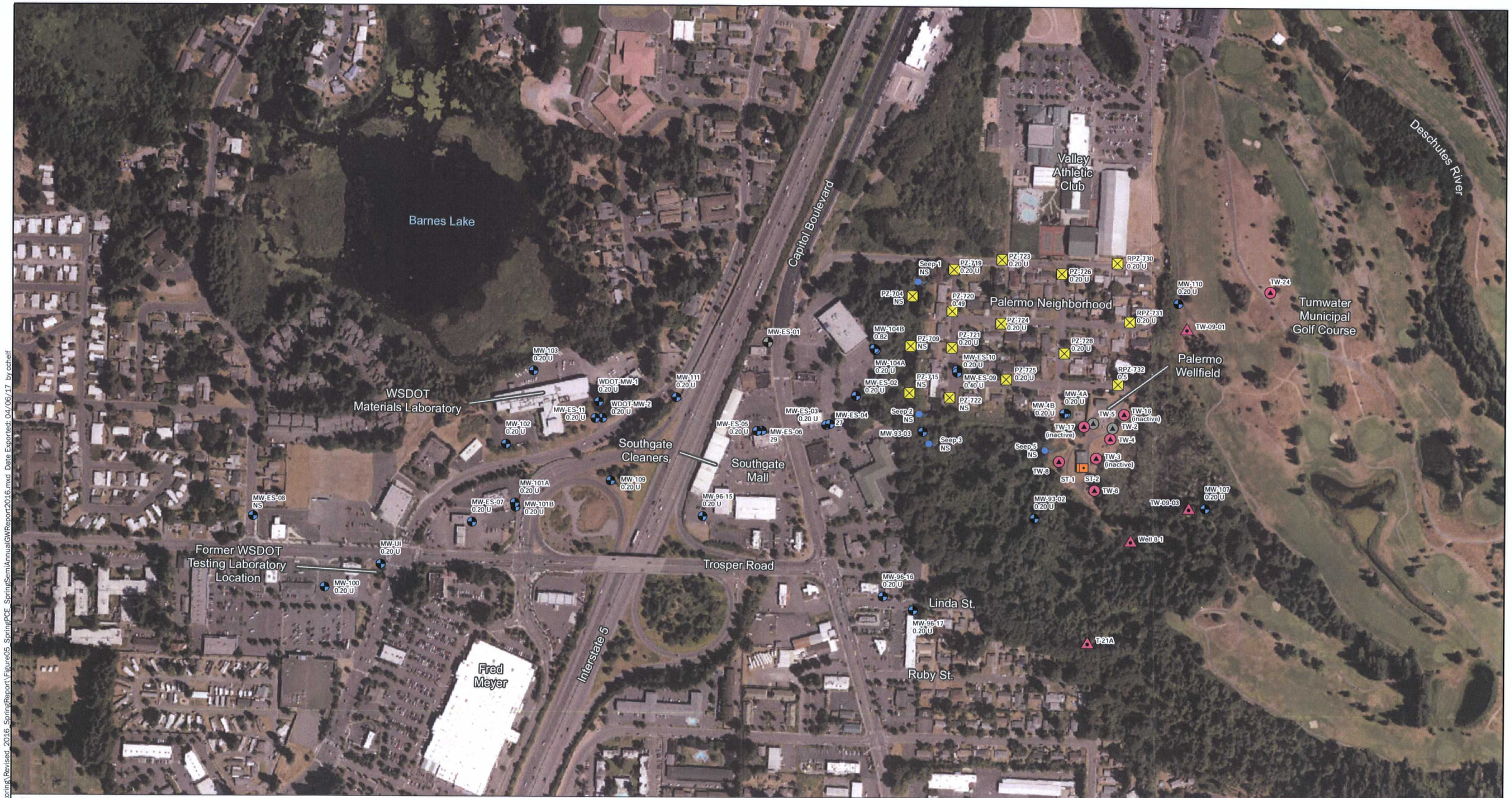
120 0 120
Feet

Spring 2016 - Palermo Neighborhood Shallow Groundwater Elevations

Palermo Wellfield Superfund Site

GeoEngineers

Figure 4



Notes:

1. Concentrations presented in µg/L.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
4. TW-3, TW-16 and TW-17 are installed but not operating.
5. Groundwater samples collected April 19 to 28, 2016.

Data Source: Long-term monitoring locations from Parametrix 2012 and modified using Surveyed well and piezometer locations by Skillings Connolly, Inc Oct 2014. Imagery from Thurston County GIS 2015. Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

- Monitoring well and identifier
- Piezometer and identifier
- Groundwater seep and identifier
- City production well and identifier
- City test well and identifier
- Stripper tower and identifier
- Former city production well and identifier
- Former monitoring well and identifier
- Barnes Lake staff gauge
- U — Compound not detected at the reporting limit
- NS — Not Sampled

N W E S

400 0 400

Feet

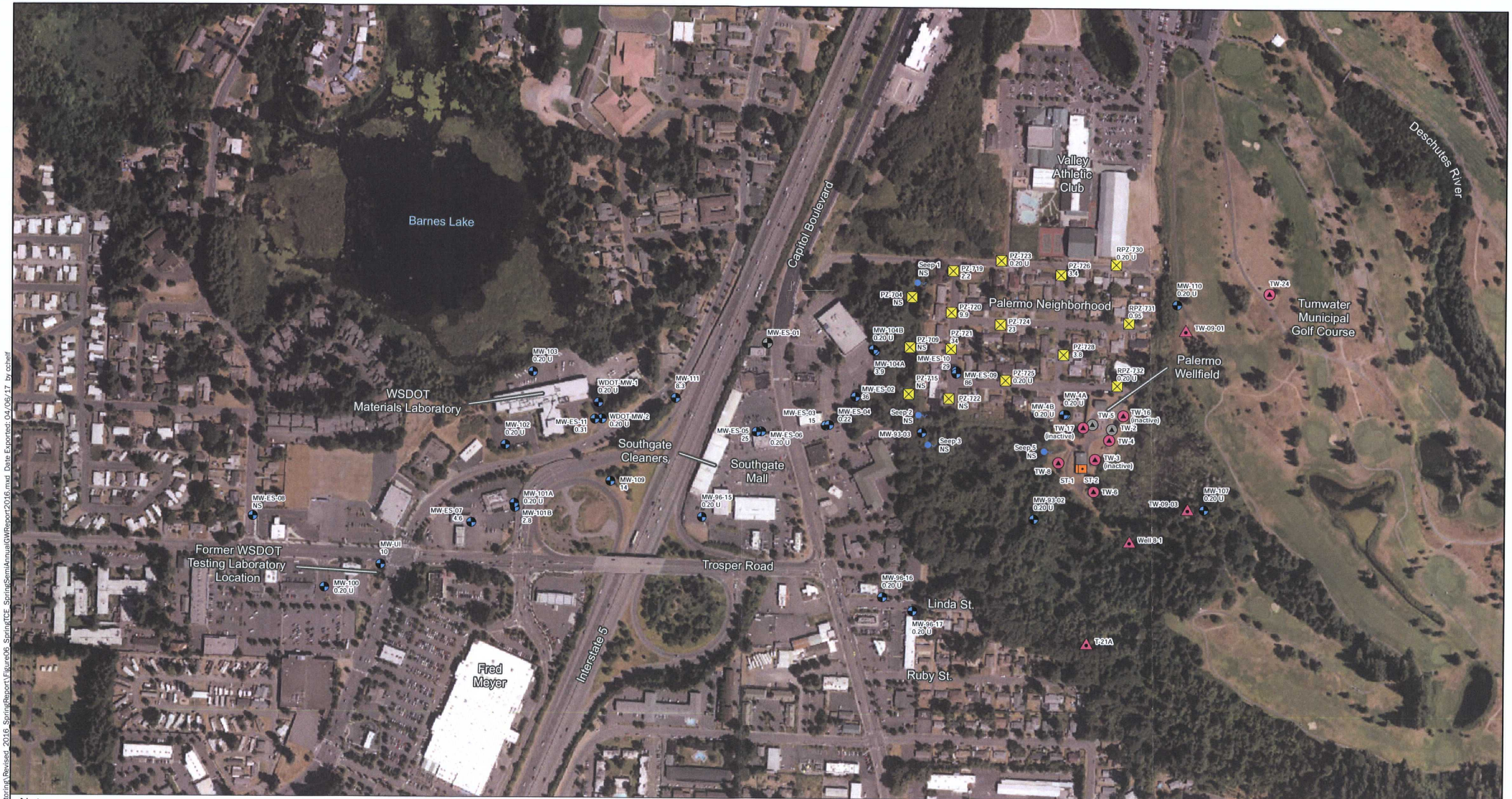
Spring 2016
PCE Concentrations in Groundwater (µg/L)

Palermo Wellfield Superfund Site

GeoEngineers

Figure 5

P:\0\0180121\GIS\MXDs\GroundWater Monitoring\Revised 2016 SpringReport\Figure05 SpringPCE SpringSemiAnnualGWReport2016.mxd Date Exported: 04/06/17 by ccneif



Notes:

1. Concentrations presented in µg/L.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
4. TW-3, TW-16 and TW-17 are installed but not operating.
5. Groundwater samples were collected from April 19 to 28, 2016.

Data Source: Long-term monitoring locations provided by Parametrix 2012 and modified using surveyed well and piezometer locations by Skillings Connolly Inc, Oct 2014. Imagery from ESRI 2013. Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

- Monitoring well and identifier
- Piezometer and identifier
- Groundwater seep and identifier
- City production well and identifier
- City test well and identifier
- Stripper tower and identifier
- Former city production well and identifier
- Former monitoring well and identifier
- Barnes Lake staff gauge
- U — Compound not detected at the reporting limit
- NS — Not Sampled

N W E S

400 0 400

Feet

Spring 2016
TCE Concentrations in Groundwater (µg/L)

Palermo Wellfield Superfund Site

GeoEngineers

Figure 6

P:\0\0180121\GIS\MXDs\GroundWater Monitoring\Revised 2016 SpringReport\Figure06 SpringTCE SpringSemiAnnualGWReport2016.mxd Date Exported: 04/06/17 by cchelf

359 (CO1)		Spring
	PCE (µg/L)	4.4
	TCE (µg/L)	10
	Flow(gpm)	158

358 (CO4)		Spring
	PCE (µg/L)	7.0
	TCE (µg/L)	14
	Flow(gpm)	142

357 (CO6)		Spring
	PCE (µg/L)	10
	TCE (µg/L)	7.9
	Flow(gpm)	63

364 Deschutes River POC		Spring
	PCE (µg/L)	0.20 U
	TCE (µg/L)	0.41
	Flow(gpm)	1906

361 (Lagoon effluent)		Spring
	PCE (µg/L)	0.26
	TCE (µg/L)	0.73
	Flow(gpm)	1667

350 (M St storm drain)		Spring
	PCE (µg/L)	0.20 U
	TCE (µg/L)	1.3
	Flow(gpm)	111

360 (tight line outfall)		Spring
	PCE (µg/L)	4.1
	TCE (µg/L)	9.6
	Flow(gpm)	190

356 (Upstream)		Spring
	PCE (µg/L)	0.20 U
	TCE (µg/L)	0.20 U
	Flow(gpm)	NC

Notes:
1. TW-3, TW-16 and TW-17 are installed but not operating.
2. Subdrain and lagoon samples were collected on April 26, 2016.
3. The locations of all features shown are approximate.
4. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
5. Discharge for station 361 is measured at an outfall approximately 800 feet downstream at a pond located north of the Tumwater Athletic Club.
6. Station 364, the Deschutes River Point of Compliance (POC) point, is located at the Deschutes River Outfall located approximately 2,000 feet downstream from the treatment lagoon.
7. No flow or samples were collected at Station 362 because water was not present.

Data Source: Long-term monitoring locations from Parametrix 2012. Subdrain layout provided by URS 2000 and modified using surveyed cleanout and catch basin point locations by Skillings Connolly, Inc. Oct 2014, Imagery from Thurston County GIS 2015.

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Monitoring well and identifier
Piezometer and identifier
Groundwater seep and identifier
City production well and identifier
City test well and identifier
Stripper tower and identifier
Former city production well and identifier
Catch basin and identifier
Subdrain cleanout sampling station and identifier
Treatment lagoon sampling station and identifier
Cleanout location and identifier
U — Compound not detected at the reporting limit
NC — Not calculated
Subdrain tightline pipe
Subdrain perforated pipe

120 0 120
Feet

Spring 2016 - Subdrain and Treatment Lagoon Monitoring Results, Palermo Neighborhood

Palermo Wellfield Superfund Site

GeoEngineers

Figure 7

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APPENDICES

GeoEngineers

APPENDIX A
Field Forms
(On Attached CD)

APPENDIX B
Analytical Data Summary Tables

Table B-1

Groundwater Results

Spring 2016 Semiannual Groundwater Monitoring Report
Palermo Wellfield Superfund Site
Tumwater, Washington

Location	Sample ID	Date	Type	1,1-Dichloroethene (µg/L)	cis-1,2-Dichloroethene (µg/L)	Tetrachloroethene (µg/L)	Trans-1,2-Dichloroethene (µg/L)	Trichloroethene (µg/L)	Vinyl Chloride (µg/L)
MW-100	MW-100-160419	4/19/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-101A	MW-101A-160419	4/19/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-101A	DUP-1-160419	4/19/2016	Duplicate	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-101B	MW-101B-160419	4/19/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**2.8**	0.20 U
MW-102	MW-102-160420	4/20/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-103	MW-103-160420	4/20/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-104A	MW-104A-160422	4/22/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**3.9**	0.20 U
MW-104B	MW-104B-160422	4/22/2016	Primary	0.20 U	0.20 U	**0.82**	0.20 U	0.20 U	0.20 U
MW-104B	DUP-2-160422	4/22/2016	Duplicate	0.20 U	0.20 U	**0.8**	0.20 U	0.20 U	0.20 U
MW-107	MW-107-160421	4/21/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-109	MW-109-160419	4/19/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**14**	0.20 U
MW-110	MW-110-160421	4/21/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-111	MW-111-160421	4/21/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**8.3**	0.20 U
MW-4A	MW-4A-160420	4/20/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-4B	MW-4B-160420	4/20/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-93-02	MW-93-02-160421	4/21/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-96-15	MW-96-15-160420	4/20/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-96-16	MW-96-16-160421	4/21/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-96-17	MW-96-17-160421	4/21/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-ES-02	MW-ES-02-160422	4/22/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**36**	0.20 U
MW-ES-03	MW-ES-03-160421	4/21/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**15**	0.20 U
MW-ES-04	MW-ES-04-160421	4/21/2016	Primary	0.20 U	0.20 U	**27**	0.20 U	**0.22**	0.20 U
MW-ES-05	MW-ES-05-160422	4/22/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**25**	0.20 U
MW-ES-06	MW-ES-06-160422	4/22/2016	Primary	0.20 U	0.20 U	**29**	0.20 U	0.20 U	0.20 U
MW-ES-07	MW-ES-07-160419	4/19/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**4.6**	0.20 U
MW-ES-07	DUP-2-160419	4/19/2016	Duplicate	0.20 U	0.20 U	0.20 U	0.20 U	**4.7**	0.20 U
MW-ES-09	MW-ES-09-160422	4/22/2016	Primary	0.40 U	0.40 U	0.40 U	0.40 U	**86**	0.40 U
MW-ES-10	MW-ES-10-160422	4/22/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**29**	0.20 U
MW-ES-11	MW-ES-11-160420	4/20/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**0.31**	0.20 U
MW-UI	MW-UI-160419	4/19/2016	Primary	0.20 U	**0.24**	0.20 U	0.20 U	**10**	0.20 U
PZ-719	PZ-719-160428	4/28/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**2.2**	0.20 U
PZ-720	PZ-720-160428	4/28/2016	Primary	0.20 U	0.20 U	**0.49**	0.20 U	**9.9**	0.20 U
PZ-721	PZ-721-160428	4/28/2016	Primary	0.20 U	**0.26**	0.20 U	0.20 U	**34**	0.20 U
PZ-723	PZ-723-160427	4/27/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
PZ-724	PZ-724-160428	4/28/2016	Primary	0.20 U	**0.26**	0.20 U	0.20 U	**23**	0.20 U
PZ-725	DUP-2-160428	4/28/2016	Duplicate	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
PZ-725	PZ-725-160428	4/28/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
PZ-726	PZ-726-160427	4/27/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**3.4**	0.20 U
PZ-728	PZ-728-160427	4/27/2016	Primary	0.20 U	**0.22**	0.20 U	0.20 U	**3.8**	0.20 U
RPZ-730	RPZ-730-160427	4/27/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RPZ-731	RPZ-731-160427	4/27/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**0.95**	0.20 U
RPZ-732	RPZ-732-160427	4/27/2016	Primary	0.20 U	0.20 U	**0.5**	0.20 U	0.20 U	0.20 U
WDOT-MW-1	WDOT-MW-1-160420	4/20/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
WDOT-MW-2	WDOT-MW-2-160420	4/20/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U

Notes:

µg/L = microgram per liter

U = Indicates analyte was not detected at or above the reported detection limit.

Bold = Indicates analyte was detected above the method detection limit.

Table B-2

Subdrain Results

Spring 2016 Semiannual Groundwater Monitoring Report

Palermo Wellfield Superfund Site

Tumwater, Washington

Location	Sample ID	Date	Type	1,1-Dichloroethene (µg/L)	cis-1,2-Dichloroethene (µg/L)	Tetrachloroethene (µg/L)	Trans-1,2-Dichloroethene (µg/L)	Trichloroethene (µg/L)	Vinyl Chloride (µg/L)
Sub-Drain System									
350	350-160426	4/26/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**1.3**	0.20 U
356	356-160426	4/26/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
357	357-160426	4/26/2016	Primary	0.20 U	0.20 U	**10**	0.20 U	**7.9**	0.20 U
357	DUP-1-160426	4/26/2016	Duplicate	0.20 U	0.20 U	**10**	0.20 U	**7.8**	0.20 U
358	358-160426	4/26/2016	Primary	0.20 U	0.20 U	**7**	0.20 U	**14**	0.20 U
359	359-160426	4/26/2016	Primary	0.20 U	0.20 U	**4.4**	0.20 U	**10**	0.20 U
360	360-160426	4/26/2016	Primary	0.20 U	0.20 U	**4.1**	0.20 U	**9.6**	0.20 U
361	361-160426	4/26/2016	Primary	0.20 U	0.20 U	**0.26**	0.20 U	**0.73**	0.20 U
364	364-160426	4/26/2016	Primary	0.20 U	0.20 U	0.20 U	0.20 U	**0.41**	0.20 U

Notes:

µg/L = microgram per liter

U = Indicates analyte was not detected at or above the reported detection limit

Bold = Indicates analyte was detected above the method detection limit.

APPENDIX C
Data Validation Reports

GeoEngineers

Data Validation Report

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Project: Palermo Wellfield Remedial Investigation and Feasibility Study
April 2016 Semiannual Groundwater Monitoring and Subdrain System Sampling

GEI File No: 0180-121-11

Date: May 19, 2016

This report documents the results of a United States Environmental Protection Agency (USEPA)-defined Stage 2B data validation (USEPA Document 540-R-08-005; USEPA 2009) of analytical data from the analyses of water samples collected as part of the April 2016 Semiannual Groundwater and Subdrain System sampling events, and the associated laboratory and field quality control (QC) samples. The samples were obtained from the Palermo Wellfield Superfund Site located in Tumwater, Washington.

OBJECTIVE AND QUALITY CONTROL ELEMENTS

GeoEngineers, Inc. (GeoEngineers) completed the data validation consistent with USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (USEPA 2014) (National Functional Guidelines) to determine if the laboratory analytical results meet the project objectives and are usable for their intended purpose. Data usability was assessed by determining if:

- The samples were analyzed using well-defined and acceptable methods that provide reporting limits below applicable regulatory criteria;
- The precision and accuracy of the data are well-defined and sufficient to provide defensible data; and
- The quality assurance/quality control (QA/QC) procedures utilized by the laboratory meet acceptable industry practices and standards.

In accordance with the Field Sampling Plan, Semiannual Groundwater Monitoring (GeoEngineers 2013a) and Quality Assurance Project Plan Subdrain System and Treatment Lagoon Sampling (GeoEngineers 2013b), the data validation included review of the following QC elements:

- Data Package Completeness
- Chain-of-Custody Documentation
- Holding Times and Sample Preservation
- Surrogate Recoveries
- Method, Trip, and Rinsate Blanks
- Matrix Spikes/Matrix Spike Duplicates
- Laboratory Control Samples/Laboratory Control Sample Duplicates
- Field Duplicates (FDs)
- Internal Standards

- Initial Calibrations (ICALs)
- Continuing Calibrations (CCALs)
- Reporting Limits

VALIDATED SAMPLE DELIVERY GROUPS

This data validation included review of the sample delivery groups (SDGs) listed below in Table 1.

TABLE 1: SUMMARY OF VALIDATED SAMPLE DELIVERY GROUPS

Laboratory SDG	Samples Validated
1604-158	MW-100-160419, MW-ES-07-160419, DUP-2-160419, MW-UI-160419, RB-2-160419, TB-2-160419
1604-159	MW-101A-160419, DUP-1-160419, MW-101B-160419, MW-109-160419, RB-1-160419, TB-1-160419
1604-170	MW-103-160420, MW-ES-11-160420, WDOT-MW-1-160420, WDOT-MW-2-160420, RB-1-160420, TB-1-160420
1604-171	MW-4A-160420, MW-4B-160420, MW-96-15-160420, MW-102-160420, RB-2-160420, TB-2-160420
1604-181	MW-93-02-160421, MW-107-160421, MW-110-160421, MW-ES-03-160421, RB-1-160421, TB-1-160421
1604-182	MW-96-16-160421, MW-96-17-160421, MW-111-160421, MW-ES-04-160421, RB-2-160421, TB-2-160421
1604-202	MW-ES-02-160422, MW-ES-05-160422, MW-ES-06-160422, RB-1-160422, TB-1-160422
1604-203	MW-104A-160422, MW-104B-160422, DUP-2-160422, MW-ES-09-160422, MW-ES-10-160422, RB-2-160422, TB-2-160422
1604-230	350-160426, 356-160426, 357-160426, DUP-1-160426, 358-160426, 359-160426, 360-160426, 361-160426, 364-160426, RB-1-160426, TB-1-160426
1604-246	PZ-723-160427, PZ-726-160427, PZ-728-160427, RPZ-730-160427, RPZ-731-160427, RPZ-732-160427, TB-2-160427
1604-256	PZ-719-160428, PZ-720-160428, PZ-721-160428, PZ-724-160428, PZ-725-160428, DUP-2-160428, TB-2-160428

CHEMICAL ANALYSIS PERFORMED

OnSite Environmental, Inc. (OnSite), located in Redmond, Washington, performed laboratory analysis on the water samples using the following method:

- Volatile organic compounds (VOCs) by Method SW8260C

DATA VALIDATION SUMMARY

The results for each of the QC elements are summarized below.

Data Package Completeness

OnSite provided all required deliverables for the data validation according to the National Functional Guidelines. The laboratory followed adequate corrective action processes and all identified anomalies were discussed in the relevant laboratory case narrative.

Chain-of-Custody Documentation

Chain-of-custody (COC) forms were provided with the laboratory analytical reports. The COCs were accurate and complete when submitted to the laboratory with the exception identified below.

SDG 1604-159: The laboratory noted that for Sample RB-1-160419 the COC lists two sample vials; however, three sample vials were received.

Holding Times and Sample Preservation

The sample holding time is defined as the time that elapses between sample collection and sample analysis. Maximum holding time criteria exist for each analysis to help ensure that the analyte concentrations found at the time of analysis reflect the concentration present at the time of sample collection. Established holding times were met for all analyses. The samples within all cooler containers were properly protected with bubble wrap, preserved with wet ice and arrived at the laboratory at the appropriate temperatures of between two and six degrees Celsius, with one exception where the temperature was slightly below the lower limit, but above freezing. The out-of-compliance temperature is detailed below.

SDG 1604-256: The sample cooler temperature recorded at the laboratory was one degree Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

Surrogate Recoveries

A surrogate compound is a compound that is chemically similar to the organic analytes of interest, but unlikely to be found in any environmental sample. Surrogates are used for organic analyses and are added to all samples, standards, and blanks to serve as an accuracy and specificity check of each analysis. The surrogates are added to the samples at a known concentration and percent recoveries are calculated following analysis. All surrogate percent recoveries for field samples were within the laboratory control limits.

Method, Trip, and Rinsate Blanks

Method blanks are analyzed to ensure that laboratory procedures and reagents do not introduce measurable concentrations of the analytes of interest. A method blank was analyzed with each batch of samples, at a frequency of 1 per 20 samples. For all sample batches, method blanks were analyzed at the required frequency. None of the analytes of interest were detected above the reporting limits in any of the method blanks.

Trip blanks are analyzed to provide an indication as to whether volatile compounds have cross-contaminated other like samples within the transportation process to the laboratory. Eleven (11) trip blanks were collected (one for each cooler): TB-1-160419, TB-2-160419, TB-1-160420, TB-2-160420, TB-1-160421, TB-2-160421, TB-1-160422, TB-2-160422, TB-1-160426, TB-2-160427, and TB-2-160428. None of the analytes of interest were detected above the reporting limits in any of the trip blanks.

Equipment rinsate blanks are analyzed to provide an indication as to whether field decontamination and sampling procedures effectively prevent cross-contamination in field activities. Nine (9) equipment rinsate blanks were collected: RB-1-160419, RB-2-160419, RB-1-160420, RB-2-160420, RB-1-160421, RB-2-160421, RB-1-160422, RB-2-160422, and RB-1-160426. None of the analytes of interest were detected above the reporting limits in any of the rinsate blanks.

Matrix Spikes/Matrix Spike Duplicates

Since the actual analyte concentration in an environmental sample is not known, the accuracy of a particular analysis is usually inferred by performing a matrix spike (MS) analysis on one sample from the associated batch, known as the parent sample. One aliquot of the sample is analyzed in the normal manner and then a second aliquot of the sample is spiked with a known amount of analyte concentration and analyzed. From these analyses, a percent recovery is calculated. Matrix spike duplicate (MSD) analyses are generally performed for organic analyses as a precision check and analyzed in the same sequence as a matrix spike. Using the result values from the MS and MSD, the relative percent difference (RPD) is calculated. The percent recovery control limits for MS and MSD analyses are specified in the laboratory documents, as are the RPD control limits for MS/MSD sample sets.

One MS/MSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for all analyses and the percent recovery and RPD values were within the proper control limits.

Laboratory Control Samples/Laboratory Control Sample Duplicates

A laboratory control sample (LCS) is a blank sample that is spiked with a known amount of analyte and then analyzed. An LCS is similar to an MS, but without the possibility of matrix interference. Given that matrix interference is not an issue, the LCS/LCSD control limits for accuracy and precision are usually more rigorous than for MS/MSD analyses. Additionally, data qualification based on LCS/LCSD analyses would apply to all samples in the associated batch, instead of just the parent sample. The percent recovery control limits for LCS and LCSD analyses are specified in the laboratory documents, as are the RPD control limits for LCS/LCSD sample sets.

One LCS/LCSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for all analyses and the percent recovery and RPD values were within the proper control limits.

Field Duplicates (FDs)

In order to assess precision, field duplicate samples were collected and analyzed along with the reviewed sample batches. The duplicate samples were analyzed for the same parameters as the associated parent samples. Precision is determined by calculating the RPD between each pair of samples. If one or more of the sample analytes has a concentration greater than five times the reporting limit for that sample, then the absolute difference is used instead of the RPD. The RPD control limit for water samples is 20 percent.

SDG 1604-158: One field duplicate sample pair, MW-ES-07-160419 and DUP-2-160419, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

SDG 1604-159: One field duplicate sample pair, MW-101A-160419 and DUP-1-160419, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

SDG 1604-203: One field duplicate sample pair, MW-104B-160422 and DUP-2-160422, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

SDG 1604-230: One field duplicate sample pair, 357-160426 and DUP-1-160426, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

SDG 1604-256: One field duplicate sample pair, PZ-725-160428 and DUP-2-160428, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

One FD shall be collected and analyzed for every 20 field samples, or one per sampling event (whichever is greater), to verify the precision of laboratory and/or sampling methodology. The frequency requirements were met for all analyses.

Internal Standards (Low Resolution Mass Spectrometry)

Like the surrogate, an internal standard is a compound that is chemically similar to the analytes of interest, but unlikely to be found in any environmental sample. Internal standards are used only for the mass spectrometry instrumentation and are usually added to the sample aliquot after extraction has taken place. The internal standard should be analyzed at the beginning of a 12-hour sample run and the control limits for internal standard recoveries are 50 percent to 200 percent of the calibration standard. All internal standard recoveries were within the control limits.

Initial Calibrations (ICALs)

All initial calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. All percent relative standard deviation (%RSD) values were less than +/- 30 percent and all relative response factors (RRF) were greater than 0.05.

Continuing Calibrations (CCALs)

All continuing calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. All percent difference (%D) values were less than +/- 25 percent and all relative response factors (RRF) were greater than 0.05.

Reporting Limits

The contract required quantitation limits (CRQL) were met by the laboratory for all target analytes throughout this sampling event, with the exception of Sample MW-ES-09-160422. The CRQL was elevated from 0.20 ug/L to 0.40 ug/L in this sample, due to required sample dilution; however, the CRQL is below the ROD Remedial Goal of 5 ug/L.

OVERALL ASSESSMENT

As was determined by this data validation, the laboratory followed the specified analytical methods. Accuracy was acceptable, as demonstrated by the surrogate, LCS/LCSD, and MS/MSD percent recovery values. Precision was acceptable, as demonstrated by the LCS/LCSD, MS/MSD, and field duplicate RPD values.

No analytical results were qualified. All data are acceptable for the intended use.

REFERENCES

United States Environmental Protection Agency (USEPA). 2009. "Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use," EPA-540-R-08-005. January 2009.

United States Environmental Protection Agency (USEPA). 2014. "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review," EPA-540-R-014-002. August 2014.

GeoEngineers, Inc., 2013a. "Field Sampling Plan, Semiannual Groundwater Monitoring", prepared for Washington State Department of Transportation. February 15, 2013.

GeoEngineers, Inc., 2013b. "Quality Assurance Project Plan, Subdrain System and Treatment Lagoon Sampling," prepared for Washington State Department of Transportation. February 15, 2013.

APPENDIX D
Laboratory Analytical Data Reports
(On Attached CD)

APPENDIX E
Report Limitations and Guidelines for Use

APPENDIX E
REPORT LIMITATIONS AND GUIDELINES FOR USE

This appendix provides information to help you manage your risks with respect to the use of this report.

Report Use and Reliance

This report has been prepared for the Washington State Department of Transportation and can be distributed to Client's authorized agents and regulatory agencies including the United States Environmental Protection Agency as needed for the project.

GeoEngineers structures our services to meet the specific needs of our clients. Accordingly, no party other than the Washington State Department of Transportation may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client for this project and generally accepted environmental practices in this area at the time this report was prepared.

This report should not be applied for any purpose or project except the one originally contemplated. If important changes are made to the project or property after the date of this report, we recommend that GeoEngineers be given the opportunity to review our interpretations and recommendations, and then we can provide written modifications or confirmation, as appropriate.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we used sources that are believed to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

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